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CONTRIBUTIONS

TO THE

PATHOLOGY OF THE KIDNEY.

BY

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INTRODUCTION.

ON THE NORMAL STRUCTURAL ANATOMY OF THE KIDNEY.

The researches of modern anatomists have shown, that the secreting substance of the kidneys may be considered as essentially consisting of the ramifications of a mucous membrane, which is disposed in the form of minute tubes, clothed internally with epithelium, and closely embraced by a network of capillary vessels. These tubes, which in the cortical substance have an exceedingly irregular and tortuous distribution, pass through the pyramids, forming straight converging ducts, which unite together two by two, and finally open on the surface of the papillæ, where their epithelial lining becomes continuous with that of the calyces, pelvis, and ureters. In every part of their course, these tubes are accompanied by vessels, the ramifications of the renal artery and vein being distributed copiously in the substance of the pyramids, and over the external surface of the organ; while the cortical substance is chiefly occupied by the capillary plexuses surrounding the tubes, and by the Malpighian bodies, which have been ascertained to consist of globular tufts of vessels arising from the arteries, but whose anatomical relations and function are still the subject of much discussion.

The labours of anatomists having been thus far successful in elucidating the normal structure of the gland, it became necessary for pathologists to follow in their steps, and by the same modes of investigation to trace out the changes induced by disease in those structures which had been found to be the most essential anatomical elements of the kidney. This branch of the investigation was first taken up by Valentin,[1] Hecht,[2] and Gluge,[3] who from 1839 to 1842 published various microscopic observations on Bright's disease and other morbid conditions of the kidney. These became extensively known in Germany, and gave rise to several other contributions of much interest, but appear to have excited no attention in this country till after the publication of the papers by Dr Johnson and Mr Simon of London, in the Medico-Chirurgical Transactions for 1846 and 1847. It is proper, however, to state, that in 1842, Mr Goodsir addressed to the Medico-Chirurgical Society of this place a communication on the anatomy of the kidney, and the changes in Bright's disease, which was, so far as I am aware, the first contribution to the literature of that subject in this country; but of which an abstract only was published in the *Monthly Journal* for that year.[4]

The researches which I am now about to publish, were at first undertaken, and indeed had proceeded a considerable way, with a very imperfect knowledge, on my part, of what had been previously observed by others. In consequence of this circumstance, I was led to the minute and careful investigation of some minor points in regard to the normal anatomy of the gland, which I might perhaps have neglected had I possessed the confidence which the examination of Gluge's drawings would have given me. Nevertheless, as no one appears to me to have observed and defined with sufficient exactness the *standard of health* in the human kidney with relation to microscopico-pathological researches, I have thought it might be desirable to introduce the strictly pathological part of this inquiry by a few observations on the healthy structure, premising that I mean to notice only such points as are important in reference to pathology, and by no means to attempt any thing like a complete account of the normal anatomy of the gland.

1. *On the Vascular System of the Kidney.*—It is well known to all who have given attention to the subject, that nothing is more variable, even in cases where no disease can be suspected, than the vascularity of the kidney. Nevertheless, there is no doubt that in some instances its abnormal character is most important as leading

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[1] Valentin's Repertorium, Bd. II. 290.

[2] De Renibus in Morbo Brightii Degeneratis, Berolin. 1839; and in Casper's Wochenschrift, 1839.

[3] Observationes Anatomico-Pathologicæ.

[4] Dr H. Bennett informs me that he has, for several years, explained in his classes the views on stearosis of the kidneys contained in Gluge's work; which he had also verified himself.

us to detect disease of the organ. It is therefore of some consequence to understand the conditions under which the most marked alterations of vascularity take place.

The veins of the kidney are disposed chiefly in two situations; viz. on its surface, and in the substance of the pyramids. The cortical substance contains exceedingly few. On the surface, they form a peculiar net-work, visible with the naked eye, and known to anatomists from the time of Ferrein, forming, by their intersections, the boundaries of small pentagonal or hexagonal spaces, in the interior of which the natural pale colour of the cortical substance appears, about the size of a very small pin's head (half a line). The larger veins are scattered over the surface, and tend to a stellate distribution. In this situation, the venous injection is liable to the greatest irregularity of distribution and amount (as has been well described by Rayer). The veins may appear in the highest degree distended, or, on the other hand, perfectly anemic, in correspondence with the degree of fulness of the general venous system; and no change is more frequent than the distension of veins on the posterior side of the organ, from gravitation of the blood. On the other hand, great irregularity of injection, amounting to marbling of the surface, and great increase in the size of the stellar vessels, are generally tokens of disease, as they are the result either of partial obliteration of the venous network, or of the extrusion of the blood from it through over-distension of the loops of tubuli, which form the intervening pale spaces.

The engorgement of the capillaries and Malpighian tufts gives rise to two conditions:—*first*, a generally diffused heightened colour of the cortical substance; and, *second*, increase and greater distinctness of the vascular striæ running from the base of the pyramids to the external surface. This latter species of injection often exists, to a great extent, without any corresponding injection of the rest of the kidney, and, in some instances, the red points composing the striæ are so much increased in size as to form considerable petechiæ (one line in diameter or upwards), in which case the petechiæ usually extend to the surface, occupying the intervening spaces of the venous polygons above mentioned. This appearance was supposed by Rayer to occur from simple hypertrophy and vascular injection of the Malpighian bodies; but Bowman,[1] who has shown that the Malpighian bodies do not exist on the surface of the kidney, has also given a better explanation of such petechiæ, which he holds to arise from rupture of the Malpighian tuft, with extravasation of blood into the neighbouring tubes. He argues that the petechiæ are of irregular form, and of much larger size, than the Malpighian bodies have ever been observed to acquire. He gives, also, a figure, representing the occurrence of a similar appearance from artificial injection at the surface of the kidney. In this figure the loops or knuckles of the tubuli are seen filled with injection, presenting themselves at the surface, and surrounded by the venous network. The correctness of this explanation cannot be doubted, and it is therefore evident, that the occurrence of these petechiæ must be considered as invariably morbid.

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[1] Philosophical Transactions, 1842.

The blanched and anemic state of the cortical substance is a very frequent condition. In many cases, no trace of red colour is to be seen, and the vascular striæ and points are wholly imperceptible; in others, a uniform light rose colour mingles with the pale yellowish tint peculiar to the renal substance, and the vascular points indicating the Malpighian glands are faintly visible. These conditions may coexist with abundant vascularity on the surface, and in the pyramidal portions of the kidney; and they have, since the publication of Dr Bright's researches, been looked upon by all pathologists as of the greatest importance in estimating the healthy and diseased states of the gland, particularly in reference to the granular degeneration. Rayer points out that inflammatory and other diseases of the kidney, are the most frequent of all causes of decoloration of the cortical substance; but he has also noticed the occurrence of anemia as an independent lesion in the kidney, and says, with great justice, that both in the anemic and hyperemic conditions of the organ, the partial character of the vascularity is much more decidedly indicative of the presence of a morbid product than its absolute amount.

I have had numerous opportunities of examining, microscopically, kidneys in which the cortical substance was decolorized, both where this occurred independently, and where it was connected with abnormal deposits in the organ. In such cases, the Malpighian coils of vessels, which, in a strictly normal specimen, may be observed filling the capsule, particularly towards its circumference, with red injection, are pale, bloodless, and compressed, sometimes maintaining their rounded form,—at other times, more or less angular. Along with this condition of the Malpighian bodies, I have generally observed distension of the urinary tubules, either by morbid deposit, or by the accumulation of their own secretion. In the latter case, the kidneys have usually been above the normal size, and of more or less diminished consistence. On the other hand, in cases in which the kidneys have been about or under the usual size, and firmer in texture than ordinary (without morbid deposit), I have several times observed the amount of vascular injection to be greater than usual.

In considering these phenomena with reference to their cause, it is not difficult to show, that from the anatomical constitution of the kidney, the fulness of the urinary tubules must of necessity induce, as its first consequence, compression and emptying of the Malpighian vessels. For whether we adopt the view of Bowman, who asserts the capsule of the Malpighian body to be the dilated extremity of the urinary tubule—or that of Gerlach,[1] who regards it as a diverticulum—or of Toynbee,[2] who considers it as a separate membrane retaining the tubule and the vascular coil in contact with each other, we find that the close connexion of the Malpighian vessels with the urinary tube is maintained by the majority of modern observers (although denied by Reichert and Hyrtl). If this be admitted as probable, then it follows that fluid pressure arising within the tubules must fall back upon the Malpighian vessels. Moreover, from the exceedingly firm character of its fibrous investment, the kidney cannot be suddenly increased in bulk without considerable pressure being exerted on its substance; so that, as a consequence of the anatomical disposition of the gland, the sudden engorgement of its secreting tubes must necessarily be followed, even in health, by the diminution of its vascular supply. I shall afterwards have to adduce numerous instances of the occurrence of this in the pathological states of the gland.

On the whole, it appears from the analysis of the variations in the vascular system, that the most interesting of these, in reference to pathological inquiries, are those of the Malpighian bodies; and that the varieties of the superficial venous plexus are of little consequence, excepting in the case where it is so unequally filled as to give rise to mottling or marbling of the surface.

2. *On the Tubuli Uriniferi.*—The tubes, within which the urine is secreted, are composed of an extremely delicate, translucent, and brittle membrane, the exterior of which is in contact with the capillary vessels, and the interior with a layer of nucleated cells. That these cells are intimately connected with the function of secretion has long been considered probable; and the researches of Goodsir comprise observations extending over so wide a series of secreting structures, and so apposite, as almost to amount to demonstration,[3] that the epithelium of the ultimate glandular ducts is the immediate agent in the process of secretion. Hence the pathological alterations of these structures have become of peculiar importance.

In the kidney of the human subject, the appreciation of the normal characters of the tubuli, and of their epithelium, is a task of no small difficulty. It is not always easy, especially in hospitals situate among the population of large towns, to find organs which can be relied upon as furnishing a standard of health; and, even in those which present no obvious marks of disease, the variations observable in a minute examination of the tubes, are so frequent and considerable, as to present the greatest difficulties to the unpractised observer. With the view of familiarizing myself with these variations, I examined, during nearly two months (with the kind concurrence, and frequently also the valuable aid of Dr Bennett), all the kidneys, with few exceptions, which were removed at the *post-mortem* examinations in the Edinburgh Royal Infirmary. The following results of this inquiry may be useful to those engaged in similar observations, by preventing the mistake of healthy for diseased conditions.

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[1] Muller's Archiv. 1845, No. IV.

[2] Med. Chir. Tran., Vol. XXIX.

[3] This is peculiarly evident from his observation on the testis of the Squalus Cornubicus, where the actual process of secretion may be said to take place under the eye.—*Anat. and Path. Observations*, No. V., *and Trans. Royal Society of Edin.* 1842.

The lining membrane of the tubuli, which is the homogeneous or basement membrane of Bowman, is never seen in the fresh and healthy kidney uncovered by epithelium-cells, the nuclei of which are ranged, at pretty nearly equal distances, over its internal surface. In certain diseased states, and also as the effect of maceration, there may sometimes be seen in the kidney considerable portions of tube having a perfectly homogeneous character, and perfect transparency, with no appearance of structure. Much more commonly the tube is seen destitute of epithelium-cells, but retaining in its walls a few scattered oval nuclei, about one-third smaller than the nuclei of the epithelium-cells. These are the young epithelium-nuclei of Bowman, the germinal centres of Goodsir. They appear imbedded in the substance of the membrane, and are very rarely separated from it even when, in diseased conditions of the kidney, the tube has ceased altogether to perform its function. Observations illustrative of these facts will be given in a succeeding part of this memoir.

The membrane of the tubuli appears to be possessed of considerable elasticity, so as to be capable of accommodating itself to the greater or less amount of secretion within them. In no case is it thrown into folds when the tubes are *in situ*, even when the calibre of the tube is very much narrowed. In the strictly normal kidney, however, the diameter of the tubuli varies much less than might be supposed, being generally, in all parts of the organ, from 1-25th to 1-15th of a millimetre. This is no doubt owing to the constant nature of the secretion, and the freedom with which it escapes as it is secreted, on account of which the tubes are not, like the ducts of the mammary gland, subject to alternate distension and relaxation.

The epithelium-nuclei of the tubule are, as above stated, in the normal state arranged at somewhat regular intervals on the inner surface of the membrane, the intervening spaces being occupied, and entirely filled up by the cell-walls, which, when *in situ*, assume an irregularly polygonal form from mutual pressure, according to the amount of distension of individual cells. The cavity of the tubule appears to be entirely filled up by these cells and by the secretion which distends them, and which, when freed, filters away between them.

The size of the nuclei is pretty constantly from 1-120th to 1-100th of a millimetre. They are circular, and have an extremely clear, well-defined edge, which is perfectly smooth when the kidney is fresh; but occasionally, from putrefaction or other causes, becomes slightly irregular, destroying the circular form of the nucleus. They appear quite flat by every arrangement of the light, and when seen sideways become oval or nearly linear. By transmitted light they have a slight uniform shadow, and present one or two central dark points, which, however, are not constant in their occurrence and position. I have not observed the nuclei to present the phenomena of endosmosis and exosmosis. The addition of water produces little change on them; acetic acid generally makes them clearer than before, but rather by dissolving away surrounding obscurities than by any change in the nucleus itself.

The cell-wall is extremely delicate, sometimes indeed so much so as to be scarcely visible, even with the most careful management of the light; but if a current be produced in the fluid, when the nuclei are floating free on the field of the microscope, the presence of the cell may always be recognised, even when it is most delicate, by its preventing the complete approximation of the nuclei to one another. In a certain proportion of the nuclei, also, it appears to be absent even in the most healthy kidneys; and I have frequently seen organs presenting no other apparent change, in which the proportion of free nuclei was so large that it was difficult to find a complete cell among them. Of this circumstance, and also of the extremely different degrees of tenuity of the cell-wall, where it is present, I am not able to offer an explanation, further than that the latter seems to have a relation to the rapidity of development of the cell; inasmuch as when the cell-development is evidently sluggish, and the tubes obstructed with granular matter, the cell-wall is in the majority of instances denser than usual.

The size of the entire cell varies considerably; it being some times but little larger than the nucleus, while at others it attains a diameter of 1-50th or even 1-40th of a millimetre. Its shape, when free, is spherical; within the tubule, however, this shape is modified by the pressure of surrounding parts. When floating free in fluid, the cells frequently roll over, showing the position of the nucleus, which is attached to the side.

The fluid contained in the cells of the tubules, being in fact their own secretion, is, in the strictly normal state, perfectly transparent. Nevertheless, it is exceedingly common to find it clouded and rendered opaque by a minutely molecular deposit, which may be so abundant as entirely to obscure the nucleus, or may even appear distinctly granular, being at the same time scattered over the field of the microscope, and resembling very closely some of the morbid deposits to be hereafter noticed. This molecular shading of the cells is, in the greater majority of cases, owing to a deposit of lithate of ammonia, which is removed almost instantaneously by the addition of an excess of acetic acid. Such a deposit, when moderate in quantity, can scarcely be called morbid, as it takes place from the cooling of the urinary secretion under the most various circumstances, and without any other trace of the presence of disease.

It is not yet certain whether the act of secretion implies the disappearance and subsequent removal of the cell-wall, or whether the cell gets rid of its contents by a process of exosmosis, in the same way as by endosmosis it receives them from the vessels. But if the former view be correct, it is clear that the effete particles must be removed by the urine in a molecular form or in solution; as no epithelial debris of any kind can be detected in the tubes of a perfectly healthy kidney, and the existence of such debris is one of the most unequivocal and ordinary signs of disease. It is not at all improbable that the molecules of effete secreting epithelium may constitute a considerable part of that impalpable sediment which subsides from normal urine, and which is so fine as frequently to present, even under the microscope, nothing but a cloud of almost invisible molecules.

Whatever be the destiny of the cell-wall, the nucleus must be regarded as a permanent structure, whose function is the perpetual renewal of the membranous cell-wall, and of its secretion. Accordingly, the nuclei have a greater power than any other part of the organ of resisting decomposing agencies; and they are never observed in the urine except when the tubes are the seat of disease.

3. *On the connecting Tissue or Parenchyma, and the general Structural Arrangement of the Kidney.*—Toynbee, who ascribes great functional importance to the parenchyma, describes it as consisting in part of peculiar cells, similar to those within the tubes, to which bloodvessels and nerves are distributed, and which he supposes may have the office of effecting some change in the blood preparatory to the secreting process. Bowman and Goodsir describe the different anatomical elements of the kidney as connected together by a delicate fibrous tissue, which forms a sustaining skeleton for the organ.

The general arrangement of the tissues of the kidney is readily seen by making careful sections through the cortical and tubular substance with Valentin's double knife. Where such a section is made through the cortical substance, the tubes are seen sometimes in section, and sometimes presenting to view more or less of their sides, enclosed in the areolæ of an extremely delicate and lax fibrous tissue, which is so disposed as completely to fill up the interspaces. Here and there a Malpighian body is seen surrounded by its capsule, and enclosed in an areola two to four times the size of that of the majority of the tubules. By rubbing the section between plates of glass, some of the tubes may often be displaced, leaving the areolæ clear and empty, and displaying the fibrous network unaccompanied by the other tissues. These appearances are represented in the woodcuts below, although it is extremely difficult to delineate this very delicate tissue without some degree of exaggeration.

Fig. 1.

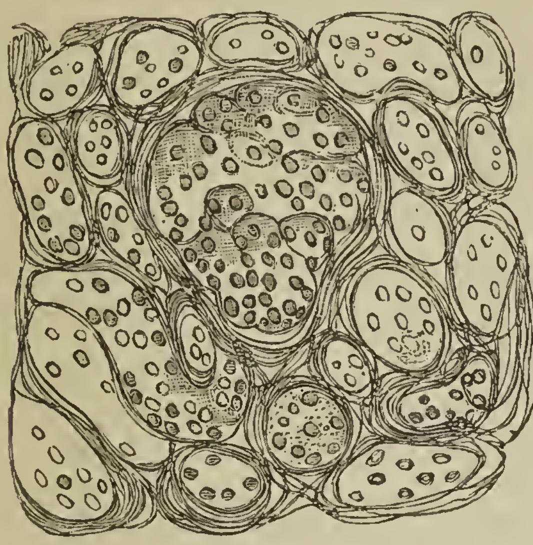

Fig. 2.

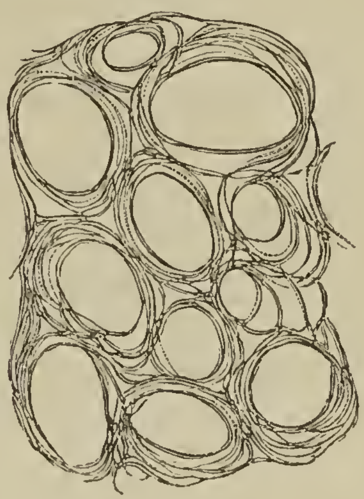

Fig. 1. *Section of the cortical substance (by Valentin's knife), treated with acetic acid, showing the tubes and a Malpighian body, with the intervening delicate areolar tissue. The nuclei are seen scattered over the field, being brought out in strong relief by the acetic acid. Magnified* 180 *diameters.*

Fig. 2. *Portion of a similar section, from which the tubes have been squeezed out. The areolæ are seen empty. Magnified* 180 *diameters.*

When the section is made through the striæ of the cortical substance, a divided bloodvessel is occasionally visible, and, whether filled with blood or not, is known by the large amount of fibrous tissue which enters into its walls. In the pyramids a similar structure is seen when they are cut across the axis of the tubes ; but, as might be expected, the fibrous tissue is much more abundant, from the greater number of large vessels included in the section.

When the capillaries are distended by natural or artificial injection, they are seen to form a close network round the tubes, running in the midst of the intertubular areolar texture above mentioned, and almost filling up the intertubular spaces. Indeed, so much of these spaces do they occupy, that I think it not improbable, that the whole, or nearly so, of the delicate fibrous tissue alluded to, is made up of the walls of the capillary plexus of vessels. Mr Goodsir and Mr Bowman, however, seem to consider it as an independent structure, the former regarding it as analogous to the capsule of Glisson in the liver.

As to the parenchymal cells of Mr Toynbee, I have not been able to observe them either in the healthy or diseased states of the kidney, and must hesitate about admitting their existence, especially as they are not described with such minuteness as to enable us to distinguish them from the epithelium of the tubes.

PART I.

ON THE PATHOLOGICAL ANATOMY OF THE KIDNEY.

In the following observations, I have endeavoured to keep constantly in view the connexion between the pathological elements and the normal structures; and also to reconcile, in as far as possible, the microscopic appearances with those visible by the unaided eye. In describing the latter, I have availed myself extensively of the works of Bright and Rayer; and the reader, to whom those works are accessible, will find in the present memoir numerous references to their excellent plates, which will serve to prevent misapprehension as to the appearances referred to.

I.—Exudation.

The exudations from the blood-vessels of the kidney, being at once the simplest and the most common of its structural changes, and being connected, either as cause or effect, with most of the other more complex conditions, require to be considered first of all.

Exudations into the substance of the kidney give rise to a great variety of external appearances. These have of late years, especially since the observations of Dr Bright upon their connexion with some of the most severe and fatal diseases, been objects of much interest to the pathologist; and have been represented and described in the works of Bright and Rayer, with a completeness and accuracy which has scarcely a parallel in the anatomy of any other organ in the body. Nevertheless, the cultivators of a more minute pathological anatomy have found the lesions of the kidney involved in greater mystery and confusion than those of any other organ whose structure and functions are equally well understood; and although some of the best modern observers have endeavoured to bridge over the chasm between our physiological and pathological knowledge, much remains still to be done.

Exudation may take place from the blood-vessels into all the tissues of the kidney. Its most common seat is the interior of the tubes; but it also occurs frequently within and around the Malpighian bodies, and in the inter-tubular tissue, the tubes being quite clear. I have also seen it infiltrated through all the tissues in the form of a homogeneous mass, which contained within it the whole of the anatomical elements of the kidney.

1. *Exudation within the Tubes.*—The process of secretion in the kidney being in fact a normal process of exudation from the blood-vessels into the tubes, and one which, from its extreme complexity, is liable to very frequent derangement, it is not surprising that, of all

the lesions of the kidney, the presence of foreign matters in the tubes should be the most frequent. The greater part of such exudations, however, are either soluble in the urine, or readily carried away by it, and only come under the notice of the pathological inquirer in connexion with the alterations in that fluid. Of this kind are the albumen in Bright's disease, and the sugar in diabetes, besides a number of soluble substances, which, although connected with morbid processes in the kidney or elsewhere, find a ready exit from the system, and do not remain to block up the tissue of the organ.

When, from any cause, the secreting cells of the kidney receive from the blood substances which do not remain in solution, obstruction of the tubes very readily takes place; much more readily indeed than in most other glands, owing to the remarkably tortuous course and narrow caliber of these tubes, and their complete occupation by the normal epithelium. If the abnormal character of the secretion continues, the obstruction is progressively increased; while, at the same time, there accumulates within the obstructed tubes a quantity of insoluble exudation, which modifies the appearance of the gland, and interferes materially with its function.

The appearance of the kidney, as altered by the presence of exudation in the tubes, is subject to variations depending on the amount of engorgement, and its partial or general character. I have already stated (See p. 5), that the almost invariable effect of the repletion of the tubes throughout the kidney, is a corresponding diminution in the fulness of the vessels of the cortical substance; particularly of the Malpighian vessels and the capillaries surrounding the tubes. Indeed, when the accumulation is considerable, the Malpighian vessels are rarely to be traced with the naked eye, as they generally are in a healthy kidney. I have shown above (*loc. cit.*) the anatomical reason of this phenomenon.[1]

However characteristic of morbid exudations into the tubes, this paleness of the kidney on section is by no means peculiar to such diseased states. It sometimes occurs as a consequence of general anæmia, and much more frequently in organs turgid from retained secretion, arising from accidental causes. Such kidneys are also frequently very soft and easily torn, often œdematous, and present a remarkable similarity in their general appearance to some of the earlier stages of exudations. In these cases the microscope is of the greatest service in enabling us to form a positive opinion; and I have so frequently been enabled to correct my own first impressions, as well as those of others, by this means, that I have ceased to repose confidence in the judgment of the unaided eye on kidneys of this description.

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[1] I take this opportunity of stating, that on this point I am compelled to differ decidedly from the views of Dr Johnson of London. It appears to me, that he has fallen into an error both of observation and theory, in ascribing the albuminous urine of Bright's disease to secondary congestion or rupture of the Malpighian bodies, caused by the distension of the tubes from accumulated fat. Not to insist further on the anatomical argument, his view is opposed by every one of Bright's own plates, which show the cortical substance uniformly pale and bloodless, with the exception of Plate V., which would probably not be admitted by Dr Johnson to be a case of Bright's disease at all, inasmuch as it presents none of the appearances of a fatty kidney. In Rayer's work, also, every plate representing the section of a granular kidney (See Plate VIII. Figs. 3 and 5—Plate IX. Fig. 8) presents a pale uninjected cortical substance; and this concurs with the descriptions of Rayer, Bright, Rokitansky, Christison, &c. It will be seen hereafter, that my views of the relation of albuminous urine to the fatty and other degenerations of the kidney, are different from the above.

The consistence of kidneys containing exudation in the tubes is very various, depending chiefly on the amount and character of the morbid deposit. The colour also varies considerably according to the kind of exudation. When this is very white and opaque, it presents itself in marked contrast to the intervening tissues, giving to the kidney on section a minutely and irregularly speckled appearance, which extends through the cortical substance, and sometimes affects also the tubular cones. It is also seen very distinctly in the intervals of the superficial venous polygons, when these have not been obliterated by pressure. This form is admirably seen in some cases where the exudation consists of salts deposited from the urine. On the other hand, when the exudation approaches nearly in colour to the kidney itself, it is frequently distinguished with great difficulty, the organ presenting a uniform paleness, without any further apparent change.

The volume and weight of kidneys containing exudation in the tubes, are frequently much increased; but this circumstance is so much under the influence of accidentally coexisting diseased conditions, that I prefer to leave it to be treated of afterwards in a separate section.

The above remarks indicate the appearances produced by exudation uniformly diffused through the tubes of the kidney; but these, though common in the slighter forms of the affection, seldom persist when the abnormal deposit has become such as to crowd any portion of the organ. It then tends to accumulate in certain sets of the convolutions in which the urinary current is least active. These, becoming partially blocked up, and ceasing entirely to secrete, are thrown aside from the general outward current of secretion, and become a centre of attraction for further deposit, just as the eddies and still water at the sides of a rapid stream receive from it the foam and floating bodies brought down from above. In this way more and more of the adjacent loops of tubuli are filled with the abnormal deposit, and become added to the former nucleus, until the masses of exudation, thus imprisoned within tubules through which no secretion passes, form irregularly rounded bodies in the cortical substance, visible to the naked eye, more or less prominent on the surface of the organ, and usually of an opaque yellowish colour. These are the granulations first described by Dr Bright, and figured in his 1st and 3d plates, and in Rayer's work (Plate

VIII. Figs. 1, 2, 5, 6, and Plate IX. Figs. 1, 5, 8). The admirable descriptions of these bodies by the last-mentioned pathologist are now well known in this country, and supersede the necessity of further detail in this place.

In 1842, Mr Goodsir described the granulations of Bright as formed by the accumulation of secreted matter within the tubes. In Germany, Gluge,[1] Hecht,[2] Eichholtz,[3] and other observers, have given descriptions of the structural relations and composition of the granulations, which, though differing in detail, concur in representing them as formed within the tubes; and in the excellent work of Lebert on microscopic pathology, a description of them will be found, which, although short, is not surpassed by any of the others in accuracy. In this country several recent observers have taken up the same view. In a paper by Mr Toynbee in the *Medico-Chirurgical Transactions*, Vol. XXIX., there are excellent plates of the anastomoses and convolutions of the tubes, and the granulations in Bright's disease, which afford valuable aid in the understanding of this subject.

The peculiar seat of the renal granulations is the cortical substance; the flow of urine through the pyramids being too constant to permit of the accumulation there of exudation in large quantity. The tendency to form granulations is generally first displayed in the neighbourhood of the surface, and also in the deep-lying convolutions between the pyramids; in both of which situations the tubes are remote from their orifices, and the pressure from behind is consequently small.

It may easily be understood, that the tubes involved in a granulation are in general permanently lost to the kidney as secreting structures; for, having ceased to perform their function, and the stream of secretion having been diverted into new channels, the re-establishment of the former ones is in the majority of cases impossible, and the useless granulations become absorbed and obliterated. The mode in which this occurs will be hereafter described.

The special characters of intra-tubular exudations next fall to be considered. Excluding tubercular and cancerous deposits, which are rare, and in regard to which I have no new observations to offer, these may be considered under three heads, viz. *a.* Crystalline or saline matters deposited from the urine; *b.* Oleo-albuminous or granular exudations from the blood-plasma; *c.* Exudations forming pus.

a. Exudations consisting of Crystalline or Saline matters deposited from the Urine after secretion.—I have already alluded to the fact, that the urate of ammonia, which so frequently occurs as a sediment in urine out of the body, is no less frequently deposited from the urine contained within the tubes of the kidney. This occurs in most cases simply as a *post-mortem* appearance, consequent upon the cooling of the body; and, when it is small in amount, it is only appreciable by the microscope. Occasionally, however, it is found in such quantity as to present to the naked eye the appearance of a distinct deposit. In such cases the cortical substance, which, when otherwise healthy, generally retains its normal vascularity, appears occupied by a white or yellowish-white opaque deposit, which presents itself also in a very marked form between the vascular striæ of the pyramids, particularly in the half nearest the cortical substance, where the vessels are more abundant than towards the apex. Such a deposit, which in reality is consistent with a perfectly healthy state of the organ, might easily be mistaken for a diseased condition. The following observation will illustrate this.

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[1] Atlas der Pathologischen Anatomie. [2] Op. cit. [3] Müller's Archiv. 1845.

Observation I.—A man, æt. thirty-five, was admitted into the Royal Infirmary, March 9th, labouring under symptoms of concussion. He had fallen from a window while in a state of intoxication, and had fractured his left tibia. There was a severe lacerated wound of the scalp. He died next day.

The body was examined March 13th. It was that of a tall and unusually robust man, perfectly well formed, and presented every appearance of perfect health. Every organ in the head, thorax, and abdomen, presented its usual appearance, except the kidneys. These were of normal size, the capsule was easily stripped, the vascular arrangement perfectly normal; but in every part of the cortical substance were seen irregular opaque white specks, contrasting strongly with the vascular redness around, and giving the organ a minutely mottled appearance. This white deposit penetrated between the striæ of the pyramidal substance. I was led to suspect its true nature by the normal character of the vascularity, and also by its penetrating so freely into the converging ducts, which are comparatively rarely the seat of other deposits. On examination by the microscope, the tubes were seen clouded and obscured by a molecular deposit, which was likewise scattered over the field, but which was completely removed by a drop of dilute acetic acid. The structure of the kidney was perfectly normal.

The distinguishing character of this deposit is its ready solubility in dilute acids, such as the acetic or nitric. Under the microscope it presents the appearance, when within the tubes, of a fine molecular shading, which entirely obscures the nuclei. That part of it which floats free on the field of the microscope, may be observed to be composed of fine molecules and granules, which, when large enough to have a defined edge, may be observed to be amorphous or angular, sometimes approaching the circular form, but never accurately rounded. Sometimes these granules cohere together in the form of opaque masses, dark by transmitted light, and of irregular form. The addition of a drop of acetic acid produces instantaneous clearness, unless the deposit be very abundant, in which case more must be added.

The following case, in which a deposit similar to the above took place to a much greater extent, and produced a distinct morbid condition of the kidney, presents many features of interest, and is one of by no means frequent occurrence. It is the only case of the kind which I have had an opportunity of observing.

Observation II.—*White Deposit in Tubes of Kidney—Cavities in Right Kidney filled with Deposit—Dysentery.*—Alexander Crichton, æt. seven, admitted into the Royal Infirmary, March 1, 1848, under the care of Dr Andrew.[1] He was excessively emaciated, and had been for ten weeks affected with constant purging and pain of the abdomen. He had been in a state of great destitution. He died March 3d, two days after admission.

The thoracic organs were healthy. The mucous membrane of the colon was thickened and ulcerated, and there were patches of lymph on the surface. At the lower end the caliber was much diminished, so as barely to admit a finger. The kidneys were much enlarged; the right weighed 4½ oz., the left 6½ oz.; surface smooth; venous injection unequal. In the left kidney cortical substance voluminous (four lines broad), mostly developed between the pyramids, protruding towards the pelvis, and closely packing in the apices of the cones. Cortical substance infiltrated throughout with small white opaque granules. On the surface these were also visible in the intervals of the venous polygons, but without disturbing the smoothness of the surface. Tubular substance compressed; but in some parts the white infiltration was seen at the base of the pyramids, at others extending nearly to the mammella. The right kidney was broken up superiorly into several anfractuous cavities, from the size of a hazelnut to that of a walnut; these cavities were filled with a diffluent white substance, which had much of the appearance of softened brain. The cavities were lined by a false membrane, which contained numerous gritty particles, and varied from two to four lines in thickness. It appeared to be composed of the condensed tissue of the gland, lined by a layer of concrete matter from the deposit contained within the cavities. In other respects, the right kidney presented the same appearance as the left. Both kidneys were tolerably firm in texture; the venous network of the surface was well injected, and the veins of the pyramids were in some parts full of blood. The cortical substance contained little blood; the vascular striæ and the Malpighian bodies were obscure.

Microscopic Examination.—The tubes were seen to be completely filled with an opaque matter, which obscured the nuclei within. Diffused in water, this matter was observed to be composed of molecules and amorphous granules (Figs. 3, 4), and of a nebulous obscuration, which under a power of 350 diameters was not wholly resolved into distinct parts. The cells, many of which were well formed and entire, were filled with a similar obscuration, which prevented the nuclei from being distinctly visible—(Fig. 4). The white opaque fluid from the cavities was composed of similar granules and molecules, in addition to which were seen some dark opaque amorphous bodies, evidently composed of aggregated granules and molecules—(Fig. 3); and in the midst of the deposit there were numerous nuclei, which were not surrounded by a cell-wall. The whole of this amorphous deposit, and all the molecules, were dissolved on adding a drop or two of dilute acetic or nitric acid; the tubes, with their cells and nuclei, then became clearly visible; nevertheless, after the addition of the acid, some of them were found to contain a few fatty granules and globules, some of which were also scattered over the field. The Malpighian bodies were mostly destitute of blood; a few were slightly injected.

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[1] I take this opportunity of expressing my thanks to the physicians of the Royal Infirmary, who have kindly permitted me to make use of every source of information as to the cases under their charge. It is right, however, to state, that I am alone responsible for the *selection* of facts in relation to the histories of disease, and for the whole account of the pathological investigations.

Fig. 3.

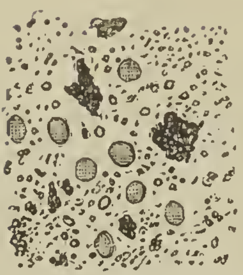

Fig. 4.

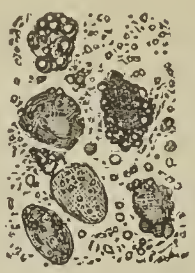

Fig 5.

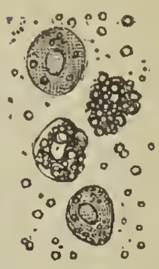

Fig. 3. Some of the white semi-fluid matter from the cavity in the kidney. It is seen to be composed of molecules and granules, interspersed with free nuclei, the debris of the epithelium cells. Some of the granules are aggregated into masses of irregular form. The perfectly spherical granules are composed of fatty exudation, which is present in limited quantity. The nuclei are slightly and uniformly shaded in their interior. (250 *diameters.*)

Fig. 4. Fluid scraped from the surface of the cortical substance in the same kidney. It differs from the last in containing entire epithelium cells, which are obscured and filled with granules and amorphous exudation. Part of this, as in Fig. 3, is composed of perfectly spherical fatty granules.

Fig. 5. The same. The urate of ammonia has been removed by acetic acid, leaving only the fatty granules and epithelium cells.

In a case in the *Medico-Chirurgical Transactions of London*, Vol. XXIX. p. 272, in which one kidney was deficient and another very extensively diseased, Mr Busk describes a deposit in the tubes of " a semi-opaque white granular material, soluble or rendered transparent by acetic acid, and presenting none of the characters of oil." In this respect, and also in the small opaque specks and white striæ described as existing in the cortical and pyramidal substances of the kidney, the case has many points of resemblance to those which I have given above; and, in as far as appears from the description, I should incline to consider this a deposit of the same kind, occurring in a kidney otherwise diseased and atrophied. Mr Busk seems to have considered it albuminous in its nature; but albuminous deposits, when amorphous or granular, are not generally found to present the ready solubility in acetic acid which is described in this case, and is always found with urate of ammonia.

Although the deposit of urate of ammonia in the tubes is of little or no pathological importance in the majority of cases, yet it occurs so frequently, and presents an appearance so much like other deposits to the unaided eye, and in some cases readily mistaken even in a microscopic examination, that I am satisfied it must occasionally have been a source of erroneous impressions to pathologists. At least I am conscious, in my own case, that I must have been frequently misled, before I was aware of the importance of applying the test of acetic acid to every deposit occurring in the kidney. This test is particularly necessary, when, as not unfrequently happens, the urate of ammonia deposit is mixed with a certain quantity of fatty granules; in which case, an idea of the relative amount of the two forms of exudation can only be obtained by the removal of one of them in the way described. (See Figs. 4, 5.)

Crystalline deposits within the tubes are of much greater rarity than the amorphous urate of ammonia. I have repeatedly seen in the tubes of diseased kidneys, small groups of perfectly circular bodies, with a clear distinct edge, of a yellowish colour, and varying in size from 1-200th to 1-80th of a millimetre. As they did not present the peculiar glistening refraction which distinguishes fatty granules and globules, I was disposed to consider them as crystals, more especially as they were very similar to those described by Dr Golding Bird (*Urinary Deposits*, Fig. 8, p. 72) as crystalline urate of ammonia. I have lately seen reason to alter this opinion, having found them to resist the action of acetic acid, and to present characters by no means compatible with the supposition of their crystalline nature. I have now ascertained, from observing their generation in urine, that they are in all probability formed out of the body as a product of decomposition; but as my observations have not yet led to any precise knowledge of the mode or circumstances of their development, I shall for the present do no more than record their occurrence.

A less questionable form of crystalline deposit has been observed by Gluge in the kidney of a dog, whose bladder contained a sanguinolent urine. The kidney presented marked capillary injection, and was considered by Gluge as being inflamed. The tubes were in some places crowded with semi-transparent crystals of very irregular form (see *Atlas d. Path. Anat. Lieferung* 10. P. II. Figs. 5-7.) Gluge has not stated the probable nature of these crystals.

In the following case I had an opportunity of observing a deposit of crystals very like those mentioned by Gluge; and, from their appearance and colour, I have little doubt that they were uric acid, although from their minute quantity they could not be submitted to chemical examination.

Observation III. *Nephritis? Pneumonia. Crystalline Deposit in the Tubes of the Kidney.*—Edward Graham, æt. twenty, labourer. Admitted into the Royal Infirmary, February 29th, under the care of Dr Douglas, on account of epigastric pain and tenderness, nausea and vomiting, accompanied by obstinate constipation, scanty high-coloured urine, and a peculiar typhoid oppression of aspect, less marked on admission than it became afterwards. Two months before admission he had a gonorrhœal discharge, for which he appeared to have taken mercury; the gums and mucous membrane of the mouth were extensively ulcerated. Three days after admission the urine was examined, and found to contain a considerable quantity of albumen, with blood corpuscles; its density was 1·017. The urine continued scanty (10-15 oz. daily), and had to be drawn off by the catheter, on account of its retention in the bladder; the typhoid depression increased; and the day before his death the physical signs of extensive pulmonary affection, without any marked symptoms, were observed. The pulse gradually became weaker, and he died on the 9th March.

On dissection, the heart and great vessels were loaded with very dark blood. Both lungs were much engorged, and a considerable portion of the left lung had passed into the state of red hepatization. The kidneys weighed 7 oz. each, and were of large size, the increase being chiefly apparent in the cortical substance, which was of a much deeper colour than natural. The radiated vascular striæ of the cortical substance were also much injected, and the points indicating the Malpighian bodies were turgid and dark-coloured. The surface showed the venous network in a state of congestion, but no other change.

Microscopic Examination.—On making a section of the cortical substance with Valentin's double-bladed knife, the gorged capillaries were seen surrounding the tubes, and apparently completely filling up the inter-tubular spaces. The Malpighian bodies were large, and injected throughout, instead of merely at their edges, as is commonly the case. In one or two places the tubes appeared full of blood; but this was not at all general. Here and there were scattered among the sections of the tubes well-defined angular bodies of different sizes, from 1-100th to 1-30th of a millimetre. Their shape was by no means regular, being sometimes imperfectly rounded, at others distinctly angular, and when so, inclining to the rhomboidal form. When isolated, their thickness appeared to be considerable, and their colour was a moderately deep amber yellow. The larger ones presented the appearance of cracks or fissures in their interior, the cleavage being generally more or less accurately parallel with the sides. On adding acetic acid, which did not affect in any way the bodies above described, many of the tubes were seen isolated, their nuclei plainly visible, and their cells free from deposit; the crystalline bodies could be seen in a few; and one, which is figured below (Fig. 6), was completely crowded by them. Comparatively few, however, were in this condition; the greater number being apparently healthy.

Fig. 6.

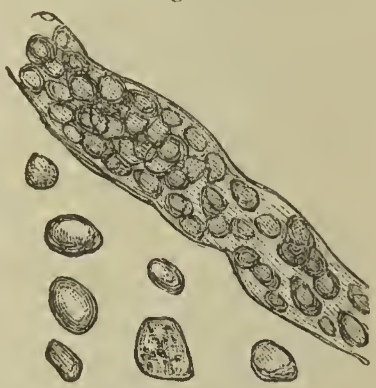

Fig 6. Irregularly crystalline deposit, probably of uric acid, in a tube from kidney of Graham. Some of the crystals are seen loose. (250 *diameters.*)

In this case we have partial suppression of the urinary secretion, which was of low specific gravity, and albuminous (partly, no doubt, from blood): in connexion with which circumstances there were symptoms of gastric irritation, such as frequently accompany disorders of the kidney, and a marked typhoid depression and stupor. It seems every way probable that this last condition was owing to the retention and accumulation of urea in the blood. These circumstances entitle us to look to the kidney as having a share in the disease, notwithstanding the absence of pain on pressure in the lumbar region, which is indeed a circumstance of little moment, when we consider that all uneasy sensation seemed to be masked, owing to the typhoid condition. Notwithstanding these functional alterations, however, there is no apparent exudation within the substance of the gland, except this minute sabulous matter in the tubes. May we not regard this last as one of the exciting causes of the disease, taken in connexion with the urethral irritation, and the state of the system induced by the action of mercury, to which he appears to have been subjected before admission?

b. Oleo-Albuminous Exudations from the Blood-plasma.—I employ this term as including, in one extended series, the whole of those exudations recognised both by German and English pathologists as fatty in their nature (the fatty granules, globules, and corpuscles of authors), together with many of those which have been distinguished as more properly inflammatory, such as the inflammation globules, granular corpuscles, or exudation granules and corpuscles of different writers. The necessity of a classification founded on the elementary structure and chemical composition, rather than on the accidental structural varieties of such exudations, is every day becoming more apparent. On the one hand, the use of the term "fatty" by pathological anatomists, though in itself most descriptive and apposite, has frequently been the means of vitiating their conclusions, and even their descriptions, when employed, as it has very frequently been, with the preconceived view that it is applicable only to chronic changes. On the other hand, the observations contained in the present memoir will be found to add new links to the chain of evidence which has been accumulating for several years past, that the so-called "inflammation" or "exudation" corpuscles, masses, and granules, are by no means characteristic of acute inflammatory processes. This conviction, which from the first induced many of the most eminent and well-informed pathological writers to withdraw the original term "inflammation globules" employed by Gluge, and to substitute for it those of granular cells, or exudation corpuscles (see the works of Henle, Vogel, and Hughes Bennett), has received a most complete confirmation from the valuable researches, lately published by Reinhardt,[1] on the nature of the granular corpuscle; in which it is proved by numerous and well-founded observations, that the corpuscle in question arises, in many instances, from the deposition of granules, consisting of fatty and protein elements, in the natural epithelium cells of different organs; and that its origin is not only in some cases independent of the inflammatory process, but frequently a purely physiological change, as in the *membrana granulosa* of the Graafian vesicle of the ovary. The occurrence of the granular corpuscles in almost every species of pathological product, is mentioned in the systematic works of Lebert and Vogel; and the readers of the *Monthly Journal* need scarcely be referred to the observations of Dr Bennett on cancerous structures, for numerous proofs of their formation in connexion with this form of chronic disease.

The fatty nature of the granules occurring in inflammatory products is known to most histologists, and is easily proved by observing the reaction of ether. Vogel[2] states, that they are composed partly of fat and in part of protein, and carbonate or phosphate of lime (the mineral elements are, however, very variable in amount). The relations of the oil to the albumen or protein, in these and other structures, has been minutely studied by Ascherson and Hughes Bennett,[3] who have shown that an albuminous membrane surrounds the oil granules, and prevents them from coalescing, as they would otherwise necessarily do; and that the formation of emulsions, where oil exists in a minute state of division, depends on a similar arrangement.

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[1] Archiv. für Phys. Pathologie, by Virchow and Reinhardt, No. I. 1847; analyzed in *Monthly Journal*, February 1848,—Retrospect, p. 6.

[2] Path. Anatomy, Dr Day's translation, p. 157.

[3] See the paper of the latter "On the Structural Relation of Oil and Albumen;" in the *Monthly Journal* for September 1847.

I have myself had repeated opportunities of observing the formation of granular corpuscles in diseased structures. In pneumonic exudation, in which they can be traced very frequently from their earliest stages, I have invariably found them to be formed from epithelial cells, according to the law laid down by Reinhardt. I have likewise satisfied myself, by repeated observations, that in some of the forms of so-called pneumonia, the quantity and size of the fat globules and granules is such as to constitute a true fatty degeneration of the lung, in the same sense in which the term has hitherto been more familiarly applied to the corresponding lesions of the liver and kidney; and that these lesions present no structural difference from the more ordinary forms, except the greater number and the larger size of the globules which accumulate in the tissue. Finally, in the case of the lung these views have been fully borne out by chemical analysis. In a series of researches by Guillot (*Gazette Médicale*, No. XXIX. 1847), it is shown, that in all diseases of the lung giving rise to obstruction of its tissue by exudation, there is an increase in the relative quantity of fatty matter, which, in the adult healthy organ, is about six per cent., but in the diseased states (such as pneumonic or tubercular infiltration) rises frequently to fifteen, and sometimes to fifty per cent. No similar analysis has yet, so far as I know, been applied to the kidney; but considerations, deduced from histological observations, give the strongest reason to suppose that in this respect, as in others, an analogy would be found between the pathological conditions of the two organs.[1]

I have entered thus far into the general pathological anatomy of this form of exudation, with the view of reconciling my own observations with those of previous writers on this subject; as also to explain my adoption of a classification which annihilates, or, at least, very much modifies, distinctions which many conceive to have a pathological significance corresponding to their practical importance. However satisfactory it might be to point out the inflammatory and non-inflammatory lesions of the kidney as presenting strongly marked pathological distinctions, I am satisfied that such an attempt would fail, from not being founded in nature or truth; and I am confirmed in this view, by the free admission, on the part of the most skilful pathological anatomists, of the extreme difficulty of making the distinction in question in the case of the kidney. Indeed, in considering the terms inflammatory and non-inflammatory as being more applicable to the modes of invasion of diseases of the kidney than to differences in their pathological anatomy, I am only following out the ideas of Rayer, who included most of them under one pathological name (Nephrite), and then distinguished them into acute and chronic.

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[1] Rokitansky enumerates inflammatory exudations as among the circumstances under which fat is deposited pathologically.—*Handbuch d. Path. Anat.*, *and British and Foreign Med. Chir. Review*, Jan. 7, 1848, p. 287.

The application of these principles to the explanation of various well-known diseases of the kidney, will be treated of in the sequel (Part II).

Oleo-albuminous exudations are distinguished by their being partially soluble in ether, which leaves an amorphous residue insoluble in cold mineral acids. The amount of this residue relatively to the whole mass, differs much in different cases, and indicates the relative amount of the protein element; it is sometimes in minute quantity, but is never entirely absent. The form assumed by such exudations is that of granules or globules, which are perfectly spherical, and present a dark distinct edge. These spherical bodies vary in size, being sometimes exceedingly minute, at other times as large as 1-60th of a millimetre, or even much larger; the variation is generally considerable in a single portion submitted to examination. Owing to their powerful refraction of light, they present a brilliant white centre and a dark circular rim, which is darkest towards the external edge.

The composition of these granules and globules has been already adverted to. The oil which forms their central portion is probably derived from the serolin, and the protein envelope from the fibrin or albumen of the blood-plasma. When the albuminous element is in large quantity relatively to the oil, the granules found are small, verging into the minutely molecular appearance; when the reverse of this is the case, they occur mostly in the form of large globules, of which the investing membrane is thin and readily ruptured by pressure. The prolonged action of acetic acid also frequently dissolves the membrane, and allows the contained fatty particles to coalesce. Caustic potass dissolves, after a time, both the albuminous and the oily element.

The mode in which the fatty granules or globules are disposed within the tubes of the kidney, next demands attention. The existence of fat in this situation was first distinctly recognised and described by Gluge as a diseased condition of the kidney, to which he gave the name of cirrhosis[1] or stearosis, with the view of distinguishing it from the states which he has described as inflammatory. In Germany, although many authors have written upon this subject, none appears to have in any way added to Gluge's later researches in his *Atlas der Pathologischen Anatomie*. In this country, the memoir of Dr Johnson of London is the only one, I believe, yet published on this subject.

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[1] Gluge uses the term cirrhosis, both in the liver and kidney, to denote the pale and yellow rather than the granulated state of the organs.

Fig. 7.

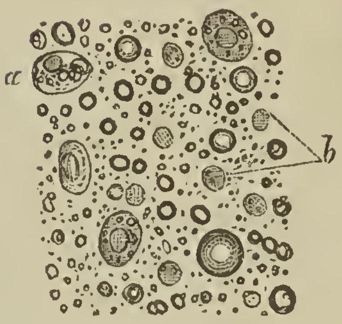

Fig. 8.

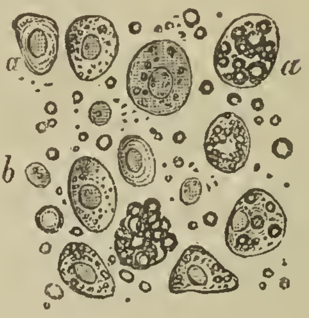

Fig. 7. *Fatty granules and globules as seen in fluid scraped from the cortical substance of a very pale and soft kidney (slightly granulated). The existence of a large number of free nuclei of epithelium cells, as at* b, b, *indicates the imperfect formation or disruption of these cells. Some of them are, however, seen entire, as at* a, *and contain fatty granules in different proportion. In this exudation the oil is relatively in large, the albumen in small quantity.* (250 *diameters.*)

Fig. 8. *Fluid scraped from cortical substance in kidney of Biggie* (*see* p. 811). *The entire epithelium cells* (a a) *are in much larger proportion than in the last case. Some of them are nearly clear, others filled in different proportions with granules, constituting the forms of cell described by authors as inflammation globules, exudation cells, fatty corpuscles, granular cells, &c.. Free nuclei* (b) *and free fat granules are also seen in considerable numbers. The proportion of oil is in this case also relatively large.* (250 *diameters.*)

According to my observations, fatty exudations from the tubes present themselves under two different aspects: *First,* free molecules, granules, and globules, intermingled with the cells and nuclei of the secreting structures; *Second,* similar granules, &c., enclosed within the cell-wall, between it and the nucleus. In regard to the first of these forms it is not necessary to repeat what has been already said; but the second demands a few words of explanation.

Dr Johnson is certainly the first who has stated distinctly, and kept constantly in view, the fact of the accumulation of fatty granules in the glandular epithelium of the kidney, having been guided in doing so by the facts previously stated by Bowman with respect to the liver. In regard to these facts there is no doubt; nor is there any doubt that their disregard by the continental writers on the kidney, has introduced much needless complexity into their descriptions.

Fatty deposit may exist in the cells of the kidney in large or small granules. It sometimes takes the form of a nearly molecular deposit; in this case it forms a mere shading, obscuring the nucleus, and rendering the cell more or less opaque. At other times, cells may be seen in different states of fulness, their contents being granules of nearly equal size, and not larger than from 1-500th to 1-300th of a millimetre. This is the granular corpuscle or inflammation globule of German writers. Again, the contained granules may be very unequal in size, the cell being irregularly distended or partially filled with granules and globules, from 1-500th up to 1-100th of a millimetre. It is rare in the kidney to find the contained granules so large as they are observed in the liver, where they not unfrequently fill nearly the entire cell. These appearances are illustrated in Figs. 7 and 8.

Fig. 9.

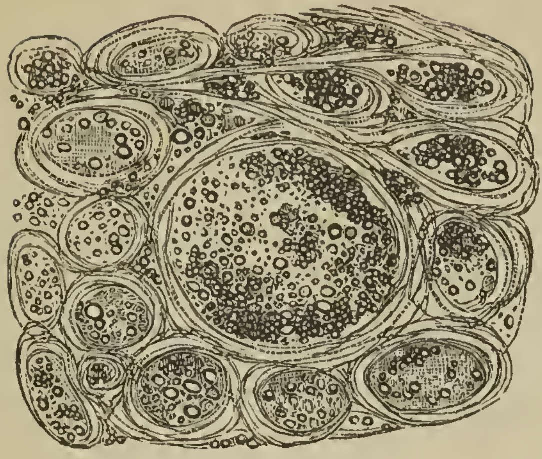

Fig. 10.

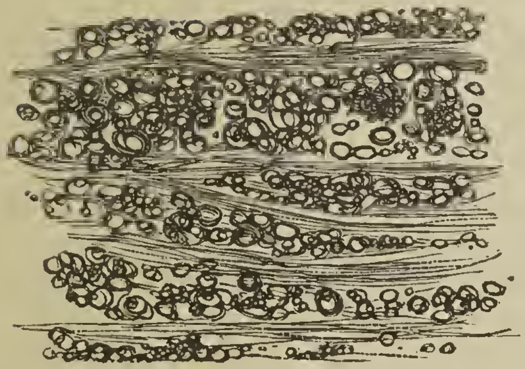

Fig. 11.

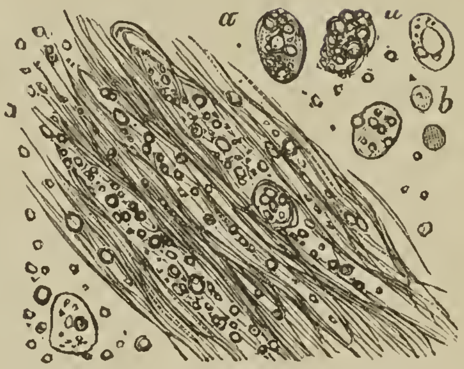

Fig. 9. Section of the cortical substance in a granulated kidney; the tubes are filled with granules and molecules of fatty or oleo-albuminous exudation. A Malpighian body is also occupied by exudation. The granules are mostly of small size. The tubes appear somewhat shrunk, the fibrous tissue having contracted around the deposit. (250 *diameters.*)

Fig. 10. Exudations, consisting of fatty globules of considerable size, in tubes of kidney of Biggie (*see* p. 811). (250 *diameters.*)

Fig. 11. Scattered granules in tubes of the pyramidal substance, in a kidney in which many of these were obliterated; a a, *cells from cortical substance of the same kidney;* b, *nuclei from do.* (250 *diameters.*)

In the tubes the fatty granules may appear to occupy the whole cavity (Figs. 9, 10), or to be sparingly disseminated (Fig. 11). Here, too, they may present every variety of size—from the smallest perceptible points or molecules, up to twice the size of the nuclei, in which case they are generally free. The tubes containing the fatty granules sometimes appear distended, at other times smaller than natural, as if they had contracted around the fat (Fig. 9). All these appearances are best seen in sections by Valentin's knife; and, when the tubes are displaced or roughly handled, the fatty deposit is very apt to be squeezed out of them.

It never happens that the whole of the tubes and cells of a kidney are equally the seat of fatty deposit. Even in the most diseased kidneys some healthy cells and tubes can generally be found; and, on the other hand, it is not unusual in kidneys apparently quite normal, to meet with a few cells containing fatty granules in greater or less number. This is, however, a departure, though a trivial one, from the strictly normal state of the cell.

The general description of the appearances produced in the kidney by the occurrence of deposits in the tubes (pp. 796-8), is applicable with peculiar force to the oleo-albuminous exudations, which are of all others the most persistent, and the most frequently disorganizing in their effects.

The following cases are selected with a view to exhibiting the different stages, and most characteristic appearances presented by this form of exudation into the tubes.

Observation IV.—*Mottled Smooth Kidney—Partial and slight Exudation of Fatty Granules in the Epithelium Cells—Deposit of Urate of Ammonia—Phthisis—Pericarditis.*—John Young, æt. thirty-eight, printer, admitted into the Royal Infirmary, October 26, 1847, under the care of Dr Robertson: had for three years suffered from cough and dyspnœa, latterly attended with night sweats, diarrhœa, and rapid emaciation. He had observed slight hæmoptysis on one occasion two years before admission. He had never had pain in the chest. On admission there was aphonia, but no urgent symptom. The normal sounds of respiration were obscure, and supplanted by mucous and subcrepitant râles, particularly in the left lung, where there was comparative dulness on percussion at the upper part as well as at the lower dorsum. He died on the 12th November, having suffered from increased cough and dyspnœa, constipation and nausea.

On examination the lungs were found extensively affected with miliary tubercle. There was dense fibrous induration, of an iron-gray colour, at the upper part of both lungs, affecting most extensively the left; and a few small dry caverns existed in the upper lobes. The pericardium contained a turbid serum, with a few shreds of lymph. The liver weighed above 4 lbs., and presented on section a pale waxy appearance; it contained rather small fatty granules in nearly all the cells. There were a few tubercular ulcers in the ileum. The kidneys weighed each above 5 oz. They presented a smooth surface, and were of firm consistence. The cortical substance was of uniform density, but slightly mottled throughout from the greater vascularity of some parts than others; the gradations of colour, however, passed insensibly into one another. The vascular injection was nowhere absent, but was on the whole diminished.

On microscopical examination, the tubes and their contained nuclei were very obscure till after the addition of acetic acid, which had the effect of rendering them perfectly distinct, apparently by the removal of a fine molecular haze. The cells were then seen to be well formed and mostly entire, but they contained in many instances fatty granules from 1-300th to 1-120th of a millimetre in diameter, which were also seen to fill some of the tubes. These could be removed entirely by ether. (When a thin section of a kidney is to be treated with ether, it should be placed, carefully spread out by needles, on a plate of glass, which should be gently inclined, and ether should then be poured drop by drop over the whole surface of the section; this will generally remove much of the oil. The section should then be taken up with the forceps, spread on a clean plate of glass, and treated with water or acetic acid in the ordinary manner. The process may require to be repeated.)

This case presents a good example of the slightest form of the fatty exudation. The organ is mottled from the unequal distribution of the vascular redness; it is slightly increased in volume; its consistence is not altered; its vessels are nowhere obliterated. The secreting cells are well formed, and the presence of an oily deposit in them is the only abnormal appearance.

The fatty exudation was in this case, as very frequently occurs, common to the liver and kidney, and was probably indicative of no special morbid tendency in either organ, but rather of a cachectic state of the system, in which the respiratory, secreting, and nutrient functions suffer a common decay. There was no symptom calculated to lead to an examination of the urine.

Observation V.—*Pale Kidney, with general Fatty Deposit in the Tubes—No Granulations. Fever? Delirium Tremens*—Robert Kirkwood, æt. fifty-six, was admitted into Dr Paterson's ward in the Royal Infirmary, on December 7, 1847, with symptoms of delirium tremens. He was ascertained to have been of intemperate habits. He died three days after admission, December 10th.

On examining the body (December 12th), there was considerable serous effusion into the subarachnoid spaces and the ventricles of the brain. The spleen weighed fifteen ounces and was softened, as were most of the organs. The kidneys weighed each four and a half ounces; they were exceedingly pale; the surface was smooth and pale, presenting only a few stellar veins; the Malpighian corpuscles were much obscured, and under the microscope appeared destitute of blood. The tubes obviously contained, throughout the cortical substance, a number of oil granules and globules of different sizes, up to the 1-100th of a millimetre. On examining the contents of the tubes separately, the oil granules were found to be mostly floating loose; the cells imperfectly formed; their membrane thin and delicate, and many of the nuclei free. (See similar appearances in Fig. 7.)

This case differs from the last chiefly in the imperfect development of epithelium, and in the more general diffusion of the exudation, which gave rise to greater paleness of the organ.

Observation VI.—*Very general Deposition of Fatty Granules in the Tubes of the Cortical and Pyramidal Substances—No Granulations—Incompetency of Aortic Valves—Hypertrophy of Heart.*—Alexander Durham, æt. twenty-nine, plumber, admitted into Edinburgh Royal Infirmary under Dr Douglas, on March 5, 1848. He had been affected from the beginning of the year with cough, dyspnœa, and palpitation, and had on one occasion expectorated a small quantity of blood. There were on admission accelerated respiration and orthopnœa, sibilant râles in the chest, and the physical signs of aortic regurgitation, with hypertrophy of the heart in a very marked form. On the 11th March there was observed slight swelling of the limbs; the urine was tested and found to be albuminous, though faintly so; it was of good specific gravity, and 18 oz. (had been generally not more than 10 oz). The œdema increased till his death, which happened rather suddenly on the 15th. On the 13th he had slight hæmoptysis, with temporary relief to the symptoms; but the orthopnœa continued to the last.

The heart weighed 22 oz., through hypertrophy chiefly of the left ventricle; the aortic valves were incompetent; the lungs were extensively studded with hemorrhagic extravasations. All the abdominal organs were normal, except the kidneys; these were above the normal weight, and dense. They were, however, very friable, so that in removing the capsule small portions of the cortical substance adhered to it. The vascular striæ opposite the bases of the pyramids were distinct; the vascularity of the capillaries and the Malpighian bodies not appreciable. The cortical substance was slightly and minutely mottled; the striæ of the pyramids, from their bases through two-thirds of their length, were marked by the presence of a white opaque deposit.

Microscopic Examination.—The greater part of the deposit proved to be granules and globules of fat, which appeared to fill the tubes in every part of the organ; it was mostly unconnected with cells. The epithelium was very imperfectly developed, many of the nuclei being free. The tubes themselves seemed in no way displaced or deformed.

In this case there was albuminous urine, constantly deficient in quantity, and generally loaded with urate of ammonia, which formed a portion of the deposit in the tubes of the kidney. There was no marked permanent disorganization of the organ; but the deposit in the tubes was as general as I remember to have seen it without such disorganization taking place.

It is to be remarked, that in the urine there was no apparent sediment except that of amorphous urate of ammonia, which disappeared on heating, leaving the urine clear. It is therefore probable that it did not contain oil in any appreciable quantity. It is to be regretted, however, that a chemical examination of it was not made.

Observation VII.—*Fatty Granules and Globules in the Tubes, extending into the Pyramidal Portion—No Granulations—Fever?*—John Biggie, æt. twenty-six, Irish labourer, admitted July 26, 1847, into Ward 3, Edinburgh Royal Infirmary, in a state of extreme prostration, with impaired intelligence, weak pulse, brown and dry tongue. He was stated to have been eight days ill of fever. His abdomen presented slight swelling, with indistinct fluctuation. On the 28th, abdominal swelling and fluctuation increased; prostration greater; some yellowness of the conjunctivæ and surface. Died. The urine could not be procured.

On dissection, the cellular tissue, which contained within its substance a good deal of fat, was infiltrated with serum. The serous cavities also contained more or less of fluid. The liver weighed 4 lbs.; it was of a nut-brown colour; its surface presented numerous mammillary projections, varying from the size of a mustard seed to that of a pea; a similar granulated disposition pervaded the whole organ. The gall-bladder contained a small quantity of bile. The spleen weighed nearly 3 lbs.; its consistence was diminished, and its colour dark. The kidneys were of normal size, flabby, and soft; the capsule brought away with it small portions of their tissue. Both cortical and pyramidal substances were very pale in colour. (Condensed from the report of Dr Waters, then pathological clerk.)

The microscopical appearances of the kidneys in this case are delineated in Figs. 8 and 10. The tubes were for the most part full of oil globules of considerable size, mixed with smaller fatty granules. Some of them were, however, nearly healthy. The deposition of fatty matter extended to the pyramids, from a section of which Fig. 10 was drawn. A section of the cortical substance presented an appearance under the microscope very like Fig. 9, but with occasionally larger globules. The epithelium cells were mostly entire and well formed, but in their interior presented various degrees of granular exudation.

In the two last observations, the deposit was connected with extreme diminution of the activity of the renal function, and this without any obvious destruction or disorganization of the substance of the organ. So far as can be judged from the pathological appearances alone, there seems to be no adequate reason why a kidney in the state above indicated should not return to health, the deposit in the tubes being removed or reabsorbed. If, on the contrary, the tendency to this deposition should continue, it seems to be inevitable that the consequence must be a complete breaking up of the structure of the organ, and such obstruction to its functions as must lead to speedy death. I have several times seen kidneys which appeared to have undergone this form of degeneration to a greater or less extent; but none so marked as in the following case, where both the liver and the kidneys seemed converted into a species of atheroma.

Observation VIII.—*Complete Atheromatous Degeneration of Liver and Kidneys—Pus in Hepatic Vein.*—Mary M'Gonagil, æt. thirty, admitted Jan. 26, 1848, into Edinburgh Royal Infirmary, under the care of Dr Douglas, with marked enlargement of the liver, apparently of five years' standing. Before this she had nine still-born and premature children. She had been subject to obstinate costiveness, and pains of the abdomen and loins. The constipation and tympanitic distension of the abdomen were overcome by remedies, and she continued pretty well till the 3d February, when marked tenderness of the epigastrium and right chest became developed, with pain on motion of the corresponding arm. On the 7th there was great and indefinite distress; the right front of the chest was the seat of a firm, diffused, and painful swelling, seated apparently in the cellular tissue. Tenderness extended from this to the axilla. The same day she died. (The urine was always very pale and scanty.)

On dissection, the surface was very pale; the thoracic organs were healthy; the liver was of large size, and exceedingly irregular form; its surface was every where uneven, at some places puckered and depressed; its substance was soft, friable, in some parts almost diffluent; it presented no appearance of structure or vascularity; scattered throughout were dense semi-transparent masses, which had the appearance on section of pieces of fibro-cartilage. The hepatic vein contained a good deal of pus. The kidneys were of the normal size, soft, and flabby; on stripping the capsule, the smoothness of the surface was seen to be diminished; this appearance, however, was found not be the result of the development of granulations of Bright, but of a peculiar condition of the cortical substance, which had lost its characteristic appearance, and became converted into a homogeneous friable mass; this, however, possessed greater consistence than that of the liver above described.

Microscopic Examination.—The texture of both liver and kidneys seemed converted into fatty granules and globules of different sizes, amid which very few secreting cells could be seen. In the kidney, however, by diluting the mass with water, fragments of tubes could be observed greatly attenuated, sometimes consisting of basement membrane alone, sometimes with a few nuclei attached. Many of these fragments were empty, others contained deposit in large quantity, and were very irregularly distended. A few loose Malpighian bodies, empty and shrivelled, were also seen. The cartilaginous-looking matter in the liver was composed of peculiar thin and delicate transparent laminæ, wholly unlike any of the normal tissues of the organ; they were insoluble in hot ether and in strong nitric acid, but I did not pursue the investigation into their nature further.

The preceding observations afford sufficiently characteristic examples of the fatty deposit in that form in which it is infiltrated in various degrees through the whole of the tubes. Very frequently, however, especially when the disease is very chronic in its character, the exudation tends to occupy particular points of the organ, leaving many of the tubes free; the points so occupied are the granulations of Bright, the formation and progress of which I have already explained. The observation which follows will illustrate this.

Observation IX. *Irregular Granulations* (early stage) *throughout the Cortical substance of Kidney—Exudation consisting of small Fatty Granules—General Dropsy.*—George Whitnall, a weaver, æt. thirty-seven, admitted January 14, 1848, into the Royal Infirmary, under the care of Dr Paterson. He had laboured under general dropsy for about twelve months, which became excessive shortly before admission. He was much prostrated, and died next day (January 15th). The urine was not procured.

The lungs were highly emphysematous; the heart slightly hypertrophied. The abdominal viscera were healthy, with the exception of the kidneys. One kidney weighed 8 oz., the other 9½ oz. The capsule was easily stripped. The surface, which was pale, approaching to a flesh-colour, with a few stellar veins, was interpersed with yellowish opaque granulations, irregular in form, and very slightly elevated. They did not exceed the size of a small pin's head, and were pretty uniformly scattered throughout the cortical substance, which was completely anemic, and sharply divided from the highly injected pyramidal substance. The latter contained a few points of yellow deposit, near the bases of the pyramids. Both cortical and tubular substance were hypertrophied.

Microscopic Examination.—The organ was so friable as not to admit of a moderately thin section being made with Valentin's knife. Owing to this circumstance the structure was very indistinctly discovered; but there was seen, disposed in irregular masses throughout the cortical substance, an exudation composed of very fine and small granules, having the refraction of oil, and not affected by acetic acid. The nuclei were abundant, the complete cells few.

This case presents an instructive instance of the earliest form of the granulations of Bright. It is that figured by Rayer (Atlas, Plate VIII. Figs. 1 and 2), and except in the slight prominence of the granulations on the surface, and their somewhat yellowish colour, corresponds exactly to his fourth form of Bright's disease, in which he describes the granulations as "petites taches d'un blanc laiteux," and as appearing "sous la forme de lignes irrégulières, comme floconneuses, qui semblent se continuer avec les stries divergentes des cônes tubuleux." The small size of the granules, forming the exudation in this case, is probably owing to the absorption of part of the oily matter, in consequence of which there is an altered relation between the proportions of the constituent parts of the exudation—(See ante, p. 21). The irregular form of the granulations, their small size, their copious diffusion through the cortical substance, and their existence even at the bases of the pyramids are all accounted for, if we consider this kidney to have passed through a stage of general fatty infiltration, similar to that of Durham or Biggie (Obs. VI. and VII). If, in either of these kidneys, the deposit had been absorbed from some of the tubes, and persisted in others, and had then become consolidated and opaque from the removal of part of its fluid constituents, they would have presented exactly the appearances here indicated.

May, then, the early stage of the granulations of Bright be considered as, in some instances, the retrograde movement of a still more threatening condition,—viz. the universal fatty infiltration?

The progress of the granulations of Bright is connected with other changes of a different character, such as atrophy of the surrounding tubes, obliteration of vessels, &c.; and will therefore come under consideration in the other sections of this memoir. Enough has been said for the present to show their connexion with the fatty exudations in the tubules.

c. Exudations in the form of Pus.—The occurrence in the cortical substance of deposits having all the external characters of pus, is not very uncommon. Their most usual form is that of small abscesses, rarely exceeding the size of a pea, and frequently much smaller, sometimes confluent, and irregularly disseminated through the cortical substance. They are generally surrounded by more or less deep vascular redness; this, however, is limited to a narrow rim around the deposit; the remaining portions of cortical substance being either natural in appearance, or paler than usual. These appearances are well delineated in Plate II. Figs. 1 and 2, of Rayer's work.

The formation of abscesses having a distinct limiting membrane, or surrounded by condensed tissue, is, in the kidney, of extremely rare occurrence. I have already related a case (Observation II.) where a cavity of this sort was found; but the appearances of the contained matters to the naked eye and under the microscope had no resemblance to those of pus.

The following case is of considerable interest in several points of view, and tends, in connexion with other observations, to elucidate the formation of pus in glandular organs :—

OBSERVATION X.—*Purulent Deposits in Kidney and Lung—Sloughing Abscess of Spleen—Peritonitis.*—Cecilia Hall, æt. twenty-seven, shoebinder, admitted Dec. 28, 1847, under Dr Douglas. Had been affected for eight days before admission with considerable fever, with rigors, vomiting, and abdominal pain. On admission the vomiting had ceased, the other symptoms continued. There was tenderness with dull percussion in the hypogastrium and left iliac region. There was also a good deal of cough. This last symptom increased considerably during the next three weeks, and the right lung became somewhat dull on percussion, with tubular respiration posteriorly, and mucous and subcrepitant râles in various parts of the chest. The abdomen became tympanitic, but the tenderness disappeared. She died much exhausted, but without pain, on Jan. 30, 1848, one month after admission.

On dissection, the heart was soft, but not altered in structure. The lungs were emphysematous, and much engorged; the upper lobe of the right lung scarcely crepitated on pressure, but floated in water. In various parts of both lungs were nodules of pulmonary tissue, which were quite dense, of a greyish colour, and some of which contained in their centres yellow creamy pus. The cavities containing the pus were found by the probe to communicate with the smaller bronchi, and were lined by a membrane having an exact resemblance to mucous membrane. The spleen was slightly enlarged and soft; in its substance, towards the convex surface, there were two or three masses of soft exudation, one of which was surrounded by a line of ulceration, and was in part detached, projecting from the surface of the organ. Around this part, and between the surface of the spleen and the diaphragm, a layer of soft yellow lymph was thrown out, which connected the opposing surfaces of the peritoneum. Stomach and intestines healthy. The kidneys were of the natural size; one of them contained in the cortical substance numerous small abscesses, from the size of a pin's head to that of a pea; several of these occurred in groups towards the surface of the kidney. The abscesses were not surrounded by any indurated substance, but by a vascular rim of a rose colour, and about half a line in diameter. They contained a bright yellow pus. A little pus was also in one or two places infiltrated into the tubular cones, near their base. The pelvis of the kidney was slightly vascular, but contained no fluid. The peritoneum lining the bladder and pelvis was somewhat vascular, and blood was extravasated in considerable quantity in the sub-peritoneal cellular tissue, both in the pelvis and about the situation of the umbilicus.

The microscopical examination of the fluid from the minute abscesses in the kidney showed the following objects:—1st, Spherical granules and molecules insoluble in acetic acid. 2d, Rounded corpuscles (Fig. 12, *b b*) of the usual size of pus corpuscles (1-100th of a millimetre), and of a dark granular appearance. On being treated with acetic acid, they became more transparent, and showed in their interior a greater or smaller number of spherical granules, and occasionally an ill-defined nucleus. On the whole, however, they underwent less change than is usual in pus from an ordinary abscess on the addition of acetic acid. 3d, Larger corpuscles from 1-80th to 1-50th of a millimetre in diameter (Fig. 12, *a a*), of nearly spherical form, and crowded with granules; on adding acetic acid they underwent little change. 4th, Extremely delicate cells (Fig. 12, *d d*) of the same size as the last mentioned, and containing a granular nucleus, about 1-100th of a millimetre, and exactly similar to the pus corpuscles described above (2d); the cell wall extremely attenuated, readily yielding to pressure, and disappearing completely after the addition of acetic acid; the space between the cell wall and the nucleus perfectly free of granules and molecules, and filled apparently with transparent fluid. On scraping the walls of one of the small abscesses gently with the point of the knife, and examining the adhering tissue, fragments of tubes were discovered, which contained all the above elements, and in which the cells and nuclei described appeared to have taken the place of the normal epithelium. The smaller corpuscles above mentioned (2d) were in greater abundance than the other elements. In the other parts of the kidney, the microscope showed nothing abnormal.

In the lung the pus presented appearances so exactly similar to the above, that the same description will apply to both.

Fig. 12.

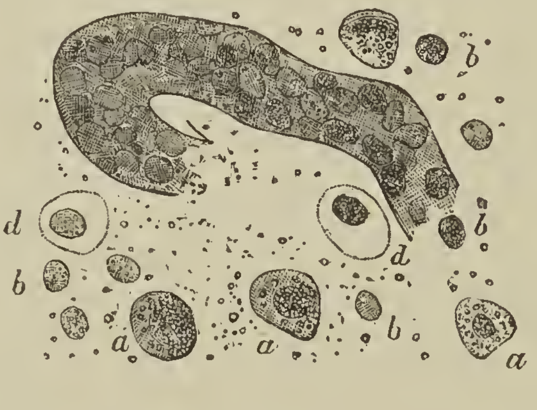

Fig. 13.

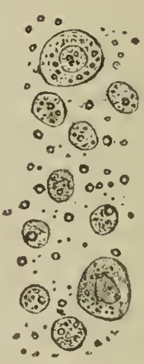

Fig. 12. *Pus and fragment of tubule from small abscess in the kidney of Hall,* 250 *diameters.* a a, *Granular cells of the size and appearance of granular epithelium.* b b, *Smaller pus corpuscles, presenting a very granular structure (most of them have been represented too flat by the engraver).* d d, *Corpuscles like the preceding, but surrounded by a cell with clear contents and an exceedingly delicate wall. The tube is seen to be filled mostly with the bodies* b.

Fig. 13. *The corpuscles treated with acetic acid.*

In the *Monthly Journal* for February 1848 (p. 589), Dr Bennett has described and figured pus corpuscles, which appeared as granular nuclei, surrounded by a delicate and transparent cell-wall. These corpuscles he has found in abscesses of the lung and kidney, and also in grey hepatization of the lungs; and he thinks that at a later stage of their formation the cell-wall disappears, leaving the nucleus as the mature pus corpuscle. From having seen Dr

Bennett's previous demonstrations, and had my attention turned to the subject, I had no difficulty in recognising the bodies, *d d*, as identical with those described by Dr Bennett. But what appears to me worthy of attention in the present case is, 1st, the coexistence of these bodies with the cells *a a*, which are undoubtedly the granular epithelium cells described in a previous part of this memoir (see ante, p. 22); 2d, the existence both of these bodies and the smaller pus corpuscles *within* the tubules, where they appeared to take the place of normal nuclei and cells; 3d, their existence in the lungs, in cavities formed by dilatations of the smaller bronchi: in short, their formation both in the lung and kidney in connexion with a mucous surface.

It is well known to microscopic observers, that the pus formed on the surface of mucous membranes seldom presents the clear and definite reaction with acetic acid characteristic of normal pus corpuscles. It has even been at different times supposed that the pus corpuscle is formed from the epithelium cell; and though this doctrine is undoubtedly attended with many difficulties, and has never been held by pathologists generally, it seems to be worthy of further investigation in cases like the present. The resemblance in size and form of the bodies *b b* to a granular epithelium nucleus, and of *a a*, *d d*, to granulated and non-granulated epithelium cells, appears, especially when taken in connexion with their position *within* the tubules, and the complete absence of normal epithelium, to be somewhat more than an accidental circumstance.

The symptoms in this case were referrible to the abdominal and pulmonary lesions described; but they were attended from the first by a marked typhoid depression, and a continued languor and exhaustion, which justified a suspicion of idiopathic fever superadded to the local disease.

In several other cases which have occurred in the Royal Infirmary of purulent deposits in the kidneys, a similar typhoid state has existed; in all, however, there have been numerous other lesions, and sometimes abscesses in other parts of the body, indicating a general tendency towards the formation of pus. The blood in these cases presented no unusual appearance.

2. *Exudation within the Malpighian Bodies.*—The granular (oleo-albuminous) form of exudation above described as so frequently occupying the tubes of the kidney, is also occasionally found within the capsules of the Malpighian bodies. When in large quantity in this situation, the tuft of vessels which normally fills the capsule, is completely compressed and shrunk, in most cases invisible. Where the exudation is in smaller quantity, however, it frequently adheres to the interior of the capsule and the exterior of the tufts, without materially affecting their form.

Exudation in this situation is generally accompanied by similar exudation, in greater or less abundance, within the tubes. The anatomical relations of these parts, as now generally understood, would, indeed, entitle us to expect that the pathological conditions of the one should be shared by the other. An exceedingly good illustration of these associated conditions will be found in Fig. 9 (see ante, p. 23). While, however, many cases of this sort have occurred to me, I have met with a still larger number which confirm the statement of Dr Johnson (*Med. Chirurg. Trans.*, vol. xxix. p. 4.), that the exudation within the tubes often occurs to a very great extent, without the Malpighian bodies being at all involved. More rarely a limited amount of deposit occurs within the latter, when there is comparatively little within the tubes. The cause of these differences is very obscure; nor does the examination of it appear to promise any results of importance, in the present extremely imperfect state of our knowledge as to the special functions of the Malpighian bodies.

3. *Exudation in the Inter-Tubular Tissue.*—In cases where oleo-albuminous exudation is in small quantity, it frequently appears to be disposed without any distinct relation to the tubes; and, where it is in very large quantity in the tubes, it sometimes appears in the interstices of the areolæ, as is represented in Fig. 9. In kidneys which are the seat of firm opaque granulations, a section of these frequently presents a dark opaque mass, covering a large portion of the field of the microscope, and showing no trace of arrangement; the deposit must, therefore, either have broken up the structure entirely, or completely occupied every vacant place. In all these cases, however, it is extremely difficult to determine by actual observation that the exudation is external to the tubes; and I am not a little disposed to doubt the occurrence of this condition, or at least to consider it as secondary to the complete occlusion of the tubes by exudation.

4. *Partial Distribution of the Oleo-albuminous Exudation.* (*Plaques Blanches de Lymphe Plastique*, Rayer.)—I have already described the formation of granulations as dependent on the accumulation of deposit in particular groups of tubules in the cortical substance. In such cases, however, the affection is probably at first general; they are very different from the form now to be described, in which the deposit is quite limited in extent, and isolated.

There are occasionally met with on removing the capsule from the surface of a kidney, irregular patches of a paler colour than the rest of the organ, sometimes a little elevated, sometimes depressed below the general surface. Their boundary is quite abrupt, and they are frequently surrounded by a well-marked rose-coloured areola, extending more or less into the surrounding substance. On making a section of these patches, they are found to penetrate into the cortical substance, and sometimes even a certain way into the pyramids. The vascular areola, when present, extends round them in every direction, and is found on examination to consist of highly injected Malpighian bodies and capillaries, with or without extravasation. The colour of the patches varies from yellowish-gray to a gamboge-yellow; their consistence is generally firm. On microscopic examination, they present a large amount of exudation, varying from the molecular to the large granular form. In some cases the tubes may be seen filled with exudation; in others, they appear to be in great part obliterated. In one case I found the Malpighian bodies quite free of exudation; they preserved their usual arrangement, and were readily discoverable by a simple lens on the surface of the section. The parts of the kidney not involved in the deposit, generally present no abnormal appearance.

Various illustrations of this species of deposit are to be found in Rayer's work. (See Pl. I. Fig. 6. Pl. V. Fig. 2. Pl. XXXIV. Figs. 2, 6.) He has figured it in various stages and under different names, as *Nephrite simple* and *rhumatismale*, and *Hemorrhagie.* Its origin and progress are very obscure, and it has not been satisfactorily connected, either with other morbid states, or with any peculiar symptoms. I have seen it in connexion with fever, with puerperal convulsions, with erysipelas and dementia, and in several cases where no account of the symptoms could be procured. Dr Bennett possesses a most remarkable preparation and drawing of a case in which such deposits were most extensively present, and left very little intervening sound tissue. The affected kidney had a most singularly variegated appearance.

II.—Lesions affecting chiefly the Vascular System.

In passing to the consideration of the morbid changes which occur in the vascular system of the kidney, the conditions of sanguineous congestion and extravasation on the one hand, and anæmia on the other, would fall to be described first in order. But the simple hyperemic and anemic states of the organ have been noticed so fully in the anatomical introduction (see pp. 2-4), that little more remains to be said on this subject.

Congestion followed by permanent obliteration of the Capillaries of the Cortical Substance.—Under this head I have to describe a form of lesion in the kidneys which, although certainly of less frequent occurrence than those characterised by exudation, is of a pathological and practical interest in no way inferior to any other.

The appearances most characteristic to the naked eye of this form of lesion, are those so admirably figured and described by Rayer as the second form of his "néphrite albumineuse." The kidneys are generally increased in size, sometimes very remarkably so. Their consistence varies; they are sometimes more flaccid than in the natural condition, but always preserve considerable tenacity. The surface is either quite smooth, or more or less depressed and furrowed. The venous vascularity assumes to a considerable extent the stellate form; the polygons are mostly absent; and the extreme irregularity and abruptness of distribution of the superficial veins gives to the surface a variegated or "marbled" appearance, which is quite characteristic of this stage of the affection. (See Rayer, Plate VI. Figs. 2, 3, 5; Bright, Plate II. Fig. 1.) Occasionally, also, amid this unequal injection there are to be found scattered petechiæ, indicating recent extravasations of blood into the tubes. On section the cortical substance has considerable volume, and presents a smooth, glistening, almost semi-transparent appearance, which cannot be better distinguished than by the term *waxy*. It may partake in a slighter degree of the variegated character of the surface; more commonly it is of uniform appearance, and of a yellowish or fawn-colour, sometimes verging into a pale flesh tint. The vascular striæ of the cortical substance are generally to be traced by a more or less distinct injection, and a few injected Malpighian bodies, or petechiæ of extravasation, are sometimes dispersed through the section. (See Rayer, Plate X. Fig. 3.) In other cases a little further advanced, both the striæ and the Malpighian bodies are nearly destitute of blood. (Rayer, Plate X. Fig. 1; Bright, Plate II. Fig. 1.) The pyramids frequently retain their normal vascularity; sometimes, however, they are of a pale colour, and their bases are indistinctly marked,—a condition which indicates the progress towards a further disorganization.

When a kidney in this condition is carefully and minutely injected, the greater proportion of the cortical substance remains impervious; the injection, however, can frequently be made to penetrate as far as the cortical striæ, and even to some of the Malpighian bodies. (See Rayer, Plate X. Fig. 2; Bright, Plate II. Fig. 3.)

From these circumstances it is obvious, that the lesion above described consists in an obliteration or obstruction of the capillary system of vessels throughout the organ, and a partial obliteration of the veins on its surface. There is also every probability that this condition is secondary to one in which there is a high degree of congestion of the organ. The extravasations, the occasionally injected Malpighian bodies, and the highly injected, though partially distributed, stellar veins, leave no doubt that the state of congestion described as the first form of albuminous nephritis by Rayer, is really the antecedent of the present or second form.

To any one who is familiar with the *marbled* and *waxy* kidney here described, there can be no difficulty in recognising a further stage of the same lesion, in which the organ is perfectly pale both on the surface and on section, with the exception, perhaps, of a very few stellated superficial veins. The kidney in this stage (the transition to which seems to be represented in Rayer, Plate VI. Fig. 4) is still heavy and voluminous; it acquires additional firmness and elasticity, and assumes much of the general appearance of a true non-vascular texture. It varies from a light yellow to a fawn-colour, which extends to the pyramids, the bases of which become still more confused and intermingled with the cortical substance than in the marbled kidney. The capsule is frequently more firmly adherent to the external surface than in health.

From the pale and yellow appearance of the kidney in this stage, it is very apt to be mistaken, even by a practised eye, for an extreme degree of the fatty degeneration. A well-marked example, indeed, will hardly give rise to this error, if attention be directed to the degree of firmness of the organ, the peculiar lustrous character of the cut surface, and the entire absence of the opaque granulations of Bright, or of that dull tint which distinguishes the excessive degrees of the fatty disease. The appreciation of these characters is, however, more difficult where, as sometimes happens, exudation is also present; and the distinction which has escaped the acute observation of M. Rayer, has undoubtedly been overlooked by many other observers.[1]

The microscopic characters of this lesion are chiefly negative. There is not unfrequently an entire absence of exudation; indeed, in the most marked cases of the lesion, I have seldom found even the slightest trace of any abnormal deposit. Occasionally, however, there is a very minute quantity of fatty exudation in the tubes, generally in very small granules, and scattered throughout the organ. The tubes are either natural, or in the advanced stages pass into some of the states hereafter to be described. The capillary vessels surrounding the tubes are not visible, and in their place there is fibrous tissue, which in this form of lesion always appears somewhat exaggerated. The Malpighian bodies are also frequently seen in process of obliteration, and surrounded by dense capsules of fibrous tissue. The epithelium is frequently altered in character, but its changes follow no fixed rule.

The absence or scantiness of exudation, taken in connexion with the extent of degeneration appreciable by the naked eye, are amply sufficient characters to distinguish this lesion from the extreme stages of the fatty disease.

I shall add three observations which illustrate the different stages and varieties of this important form of renal degeneration. I do not at present mean to enter on a consideration of the symptoms, further than to say that both Bright and Rayer have figured it as being connected with albuminous urine and dropsy; and these facts entirely concur with some of my own observations. This lesion is therefore undoubtedly one form of what is commonly called Bright's disease.

OBSERVATION XI.—*Marbled and Waxy Kidneys* (without exudation) *Bronchitis—Large Abscess in Labium.*—A woman was admitted into the Royal Infirmary in a state of great exhaustion from an abscess, the size of a child's head, connected with the external parts of generation. This was opened, but a few days after admission she died.

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[1] Plate VI. Fig. 4 of Rayer's work, is probably an example of the waxy pale kidney; Plate VII. Figs. 2, 3, 4, of the fatty disease. The distinction is sufficiently evident even in the plate. All of these are referred by Rayer to the third form of "Néphrite Albumineuse."

On dissection, November 28, 1847, the lungs were found much engorged, and the bronchi full of fluid. The kidneys were greatly enlarged, and weighed 8¼ and 6¼ oz. They were nearly of the usual consistence. The surface was very uneven, from being marked all over with irregular depressions and furrows. There was a considerable amount of venous injection, but very irregularly distributed; so much so, that the surface, which was at some parts quite bloodless, had an irregularly variegated appearance (not unlike the case of Sallaway, in Dr Bright's work, Pl. II. Fig. 1.) The depressions in the surface were mostly filled with stellated veins. On section, the cortical substance was of increased volume, particularly between the pyramids; these were broad at the bases, and the line of separation from the cortical substance was quite distinct. The pyramids were well injected; the cortical substance contained, in the line of its striæ, a few points of unusually distinct injection, but was generally anemic, being of an exceedingly pale and clear salmon-colour. The surface of the section was very smooth, and neither the section nor the surface presented the slightest trace of granulations. The mucous membrane of the pelvis of both kidneys was deeply injected with arborescent vessels. The renal veins were distended with dark blood.

On examination by the microscope, a few injected Malpighian vessels were seen; the majority were bloodless. The capillaries were uninjected. The normal epithelial cells were in great abundance; but neither in these, nor in the tubes, could any fatty granules be observed, although numerous sections were made for the purpose of determining this point.

The remarkable similarity in appearance of the section of this kidney to that in Rayer, Pl. X. Fig. 3, was noticed at the time. Both of them may be considered as good and characteristic examples of this affection, in a moderately early stage. The marks of recent vascular excitement were observable in the irregular injection of the surface, the congested state of the pelvis of the kidney, and the points of injection in the cut surface. On the other hand, the absence of exudation, and the smooth waxy appearance of the section, distinguished it from the fatty kidney. The increase in size and weight must have been owing to the great abundance of secreting epithelium within the tubes.

Observation XII. *Mottled Waxy Kidneys* (with slight exudation)—*Fatty Liver—Softened Spleen—Fever and Scurvy.*—Daniel Kean, æt. twenty-three, was admitted May 19, 1848, into a fever ward. In addition to the ordinary symptoms of eruptive typhus, he suffered from painful induration and ecchymosis in the calves of both legs, with spongy and ulcerated gums (symptoms in every way similar to those of the endemic scurvy of last year). For some time before admission he had lived very poorly, chiefly on bread and coffee. He died on June 6th.

On dissection, the lungs were congested, the heart and liver paler than usual, the spleen very soft, and slightly enlarged. The kidneys were slightly above the normal size, their capsules more firmly adherent than usual. Their surface was rendered uneven by the presence of shallow grooves and irregular dimples. The venous polygons were very obscure, being mostly supplanted by stellated and arborescent vessels, which were so distributed as to give the surface an irregularly mottled appearance. Over different parts of the surface were scattered petechiæ, varying from a dark purple to a slate colour. On section, the cortical substance appeared generally of a somewhat bright fawn colour. The cut surface was perfectly smooth, and had a waxy lustre. Here and there were seen points and lines of injection, corresponding with the vascular striæ of the cortical substance; also a few larger and deeper-coloured petechiæ. The whole of the injection was very irregularly distributed. The pyramids were paler than usual, and the line of demarcation with the cortical substance was slightly irregular. The pelvis and calyces were normal. At one point of the cortical substance, in the left kidney, there was found a patch of rather light yellowish colour, about the size of a pea, which was surrounded by a very distinct and abrupt rose-coloured border; this, on minute examination, was obviously composed of highly injected Malpighian bodies.

On examination by the microscope, the fibres of the heart were found in most places occupied by small granules, which, however, did not generally completely obscure the striæ. The liver contained oil-globules in considerable numbers, some free, and others within the epithelium cells. In the tubes of the kidneys there could be seen in many parts of the cortical substance a few minute and scattered granules, but they were mostly filled by perfectly clear cells and nuclei, which were in preternatural abundance. The nuclei were mostly smaller than usual. The inter-tubular fibrous tissue appeared unusually dense, and no injected capillaries could be seen. A few Malpighian bodies were partially injected. In the part above described as surrounded by an injected border, the tubes and cells contained granular exudation in a quantity much more considerable than elsewhere.

In this kidney, we have the waxy degeneration accompanied by a certain degree of exudation, although not to such an extent as to give any special character to the lesion. The petechiæ are interesting in connexion with the scorbutic diathesis which existed; nevertheless, the state of the superficial veins, and the injected state of some of the Malpighian bodies, along with the fact of extravasation into the tubes, appear to indicate, as in the former case, a recent condition of vascular excitement. Whether the exudation occurred as a consequence of this condition, or of the general tendency to fatty degeneration, as shown in the liver and heart, is open to question. The former view appears, from the character and partial distribution of the exudation, to be not improbable.

The succeeding case is an example of the more confirmed form of this degeneration.

Observation XIII.—*Pale yellow waxy Kidney* (without exudation)—*Enlargement of Liver and Spleen—Bronchial dilatation—Pneumonia.*—Isabella M'Kinlay, æt. twenty-three, admitted November 15th, 1847, into Ward 15 as labouring under fever. She was weak and emaciated, suffering from severe dyspnœa and cough, with fever and pain of the left side of the chest. Her complaints were of long standing, and she had had occasional diarrhœa. There were distinct physical signs of cavities in the left lung, and of general bronchitis. She was supported by wine, but continued in a febrile state, with much depression, and slight jaundice, and died December 1st.

On dissection, the heart was pale, but of natural size. In the left lung, which was much diminished in size, there were numerous large cavities. The vesicular structure of the lung was wholly obliterated, and the cavities were found to consist of dilated bronchi, the walls of which were much hypertrophied. The right lung was slightly condensed in the upper part. The liver was enlarged, pale, and firm. The spleen was large and soft. The kidneys weighed 9 oz. and 8 oz. The capsule adhered with unusual firmness. The surface was uneven and furrowed, at some points roe-like or botryoidal; but the projections here indicated had not the opacity and whiteness characteristic of the granulations of Bright (for an illustration of this point, see Rayer, Pl. X. Fig. 10). The surface was perfectly pale, with the exception of a very few straggling arborescent veins. The whole cortical substance was of a pale straw colour, tumid, and perfectly anemic ; the pyramids were very slightly mottled from vascular injection, and appeared to present straggling radiations, which were prolonged indefinitely into the cortical substance towards the surface ; the bases of the pyramids were thus rendered very indistinct. The whole kidney was of much firmer consistence than usual. Pelvis and calyces normal.

The principal microscopic appearances were dilatation of the tubes, and entire absence of all appearance of vessels. The epithelium was in considerable abundance, and had a tendency to cohere in masses, bearing the form of the tubes. Many of the cells were also compressed. A doubtful trace of granular exudation was here and there observed ; but, after a most careful search, nothing very definite could be seen.

Some of the alterations in this kidney will be considered under the head of lesions of the tubes and epithelium. At present it is sufficient to say, that this case was considered by many persons who were present to be one of fatty degeneration of the kidneys, as well as of the liver and heart. Microscopic examination proved, however, that none of these lesions existed in any appreciable degree ; the paleness of the heart and liver being, I believe, the result of anæmia, while that of the kidneys was the indication of an advanced stage of the waxy degeneration.

Connexion of Congestion with the Process of Exudation.—I have already stated, that in general the degree of fulness of the vessels stands in an inverse ratio to that of the tubes ; and that accordingly an amount of exudation, so great as to produce distension of the tubes, generally produces a corresponding depletion of the vascular system. I have likewise shown, by reference to the works of Rayer and Bright, as well as by original observations, that paleness of the cortical substance is one of the most frequent characters of kidneys containing exudation.

A moderate or small amount of exudation, however, sometimes occurs in organs which present considerable vascular injection, and sometimes even a distinctly hyperemic condition. Such cases occur not unfrequently in the latter stages of heart disease. In only one or two cases have I found the vascularity much greater than usual ; in these the kidneys were of large size (weighing from six to eight oz.), and contained very little exudation. In one instance they presented on the surface the petechiæ indicative of extravasation into the tubes (as in Bright's fifth Plate) ; in this case there had been albuminous urine and dropsy during life, with obstinate hæmaturia during two months before death ; there was also intense dysentery and disease of the liver. The kidneys were otherwise diseased ; but the exudation was in small quantity, and in very minute granules. In another case (a woman who died of convulsions in the eighth month of pregnancy, and in whom an apoplectic clot was found in brain), the kidneys weighed four and four and a half oz. ;

they were firm in texture, and of a tawny orange colour, pretty generally diffused. This was found to proceed from the presence of blood in the tubes, intermixed with small fatty granules, which were in considerable abundance. There was, however, little capillary injection, and the Malpighian bodies were mostly bloodless. The urine in this case had not been examined.

The analogy between the results of exudation in the kidney, and those in the lung and other organs, would naturally lead to the idea, that, as in the red hepatization of the lung, the deposition of granular exudation is preceded and accompanied by vascular turgescence, so in the kidney there may be a form of the exudative process in which active congestion of the organ plays a part. Almost all pathologists since the time of Dr Bright, who have written on the diseases of the kidney, have dwelt more or less strongly on the forms of renal disease, accompanied by acute symptoms and a congested state of the organ, as being the precursors, in some instances, of the more ordinary changes, in which no increased vascularity occurs; and Bright himself has indicated "an inflammatory state of the kidney" as a probable cause of the structural changes which he described and classified.—(See Bright's *Reports*, Vol. I. p. 3). This remark is strongly borne out by the case of Evans (p. 33), to which Pl. V. refers. Christison and Rayer concur in describing a state of congestion as the commencement of many of the chronic changes, and have established the coincidence of such a state, in some instances, with symptoms of acute dropsy and albuminuria. Even supposing the opinions of these authors as to the connexion between the hyperemic and anemic changes to be, as they probably are, founded partly on theoretical views as well as on direct observation, they must be admitted to be of great weight in a question which requires for its solution so large a field of experience.

From the comparatively small number of cases of acute disease of the kidney, and more especially of acute dropsy, which have occurred in the Edinburgh Royal Infirmary since my attention has been turned to this subject, I am unable to add any observations bearing more directly upon this question than those to which I have already alluded. Whether, in the two cases above mentioned, the evidences of vascular excitement, and the exudation in the tubes, can be considered as any thing more than accidental concomitant circumstances, I am not prepared to say without further opportunities of investigation; but if these cases can be considered as examples of a state of the kidney analogous to red hepatization of the pulmonary texture, I am satisfied that this state is of much rarer occurrence, or at least more rarely fatal, in the former organ than in the latter.

I have alluded incidentally to Dr Johnson's views on this subject. He considers the deposit of fatty granules in the kidney as being invariably a chronic process, never preceded, in any case, by congestion or extravasation. On the other hand, admitting that these states are frequently found in connexion with fatty exudation, he considers them as secondary results of the distension of the tubuli uriniferi.—(*Med. Chirurg. Transactions*, Vol. XXIX, pp. 4, 8, 9.) I have already shown (see p. 11), that this view is opposed both by anatomical considerations and by pathological facts; and, in particular, that the confirmed fatty degeneration of the kidney is usually accompanied by nearly complete depletion of the vessels. The comparative rarity of congestion in connexion with fatty exudation, under all circumstances, and its greater frequency while the exudation is still small in amount, sufficiently show the inadequacy of Dr Johnson's hypothesis to explain the phenomenon. The assertion of the exclusively chronic nature of the deposit in the kidney, is probably founded on an imperfect theoretical view of the nature and origin of fatty exudations in general.—(See pp. 18-20.)

On the whole, the supposition which appears to harmonize best with the analogies of other organs, and also with what has been hitherto observed in the kidney, is, that the oleo-albuminous or fatty exudation is sometimes preceded and accompanied by a congestive stage of short duration, in the course of which extravasation of blood into the tubes may occur. When, however, the exudation has accumulated within the tubes to such an extent as to cause fluid pressure by obstruction, the vascular system of the organ is emptied of its blood in a degree proportionate to the amount of distension; and, as the exudation continues to increase, the stage of congestion is rapidly superseded by the development of the pale yellowish colour so frequently mentioned in connexion with the fatty degeneration. This view appears to be strongly supported by the cases formerly mentioned, in which the oleo-albuminous exudation occurs in scattered whitish patches, surrounded by a distinct vascular rim.—(See p. 32.) On examining microscopically a section of such patches, I have observed the line of demarcation between the congested and the depleted Malpighian bodies to correspond accurately with the boundary of the exudation, so as to render it probable that the congestion, originally present throughout the diseased portion, had been superseded by the presence of the abnormal deposit.

Whether any connexion exists between the development of the congestive form of exudation and the presence of acute symptoms, is a question for further clinical experience, united with careful pathological investigation, to determine. As it is evident that the earlier stages of disease in the kidney have been hitherto to a great extent overlooked, both at the bedside and in the dissecting-room, it is highly probable that many of those affections which have been considered as most obviously chronic in their nature, may in reality be the advanced stages of processes more or less acute, which have not been fatal in the first instance, or which, if fatal, have not presented lesions appreciable by the unaided eye.

III.—Lesions of the Tubes and Epithelium.

Some of these lesions have been already fully described under the head of exudation (I.); but there remain others which are not less important in themselves than those formerly alluded to, and which are very frequently found in connexion with them.

Imperfect Development of the Epithelium Cells and Nuclei.—The natural condition of the epithelium cells has been fully described in the anatomical introduction to this memoir.—(See *ante*, p. 5.) The size of these cells, and the thickness of the cell wall, has been stated to vary within certain limits in organs apparently healthy. The size of the nuclei is less variable than that of the cells; but in all kidneys, whether healthy or diseased, the nuclei which are most closely adherent to the basement membrane are less perfectly circular, and of considerably smaller size, than the majority of those lining the tubes, and surrounded by complete cells.

Notwithstanding these differences in the normal condition, the physical characters of the epithelium is capable of affording important information as to the diseases of the kidney. In very many pathological conditions of the organ, the nuclei occur in various places almost wholly devoid of cell walls. They may be more abundant or more scanty than usual; and often appear in great profusion, huddled together in confused masses, and mixed with shreds of membrane and amorphous molecular matter, not soluble in acetic acid. This appearance of debris, which no doubt results from disintegration of the cell walls, most frequently occurs in kidneys which are abnormally soft and large, and from the cut surface of which an unusually large amount of turbid whitish juice may be scraped. It is usually impossible to obtain a satisfactory microscopic section; the cohesion and elasticity of the organ being so much impaired as to present no resistance to the pressure of the glasses. Such softened and altered kidneys occur frequently in fever and other diseases, and have appeared to me frequently to concur with deficiency in amount, or alterations in character, of the urinary secretion. I have not been able to arrive at any very definite conclusion, as to how far the disintegration in question may be the result of post-mortem change. However this may be, it is clearly abnormal, and ought always to suggest careful examination, as it is undoubtedly often connected with other morbid characters.

A more unequivocal pathological change (often occurring along with the above) is the small size and altered form of the nuclei throughout the organ. I have frequently observed the majority of the nuclei to be not more than half the usual size (some of them being even less); in this case they have always been destitute of cell walls, and have presented a more or less oval or slightly angular form. Sometimes they float scattered and solitary in the field of the microscope; at other times they appear aggregated together, either by two and three, or in much greater numbers. When a few of these aggregated nuclei are observed, it can usually be seen that they are not actually in contact, but are inclosed in a very delicate and transparent filmy substance, which is readily twisted about in all directions by currents in the fluid, but which, nevertheless, has sufficient tenacity to prevent the nuclei from being torn asunder. Occasionally, in the midst of this connecting substance, obscure marks of cell walls can be observed around the nuclei; and, from repeated observation of these varieties, I am convinced that this transparent and homogeneous film is nothing else than the nascent or undeveloped cell membrane, which has separated from the basement membrane along with the half-developed or young nuclei above detailed. These aggregations of young nuclei are sometimes mingled with the amorphous debris of effete epithelium, or with granules and molecules of oleo-albuminous exudation, or of lithate of ammonia, which communicate to them a dark and confused appearance. Not unfrequently also these masses, when freed from the tubes, retain more or less of their form, and present so exactly the appearance of the casts of the tubuli seen by Franz Simon, and many other observers, in the urine, as to leave no doubt of their identity with these bodies. —(See Figs. 17, 18.)

Desquamation of the Epithelium.—The changes above described are generally accompanied by an extremely rapid generation of nuclei, which are separated from the basement membrane in an imperfect state, and carried away along with the urine. I shall not at present enter into the subject of the changes in the urine, further than to say, that the appearance in that fluid of the immature nuclei and cells, as well as the aggregations above mentioned, forms one of the most sure and undoubted signs of a diseased condition of the urinary tubules. There is reason also to think that disease may be detected in this way, long before the kidney has undergone disorganization at all evident either to the unaided eye or to the microscope.

The analogy of the anatomical changes now described, with those which occur in diseased mucous membranes in general, deserves to be adverted to in this place. Henle was the first to show satisfactorily that the essential phenomenon of mucous catarrhs and inflammations is usually the increased formation of epithelium cells in various stages of growth, and their separation along with an increased quantity of fluid secretion. The same fact has also been clearly elicited by Lebert, in his examination into the microscopic character of expectoration.—(*Physiologie Pathologique,* Vol. I.) The analogy of the phenomena in these cases, with those presented by urine in the various disorders of the kidney, in which desquamation takes place from the tubuli, cannot fail to be appreciated, when it is remembered that the basement membrane of the tubuli is essentially a mucous structure, differing only from mucous membranes in general by its anatomical arrangement, and by its containing none of the accidental or non-essential parts of mucous tissue.

The desquamation of the epithelium of the tubuli uriniferi, has been recognised by several continental pathologists as an important characteristic of renal disease. Vogel (*Icones Histologiæ Pathologicæ*, p. 108), in particular, has furnished important observations on this subject; and several other authors might be cited as having alluded to the different forms and sequelæ of this morbid process.

In the memoirs of Dr Johnson and Mr Simon, published simultaneously in the London *Medico-Chirurgical Transactions* for last year, the desquamation of the epithelium and its anatomical results, are described, from independent observations, as characteristic of the inflammatory affections of the kidney, and as distinguishing these from the chronic *fatty* degeneration of the organ. According to Mr Simon, the latter is the exclusive result of scrofulous disease; while the desquamative disease is the consequence, in general, of a rheumatic or other *inflammatory* diathesis. Dr Johnson describes the desquamation as occurring both in an acute and chronic form, to which he gives the names of *acute* and *chronic desquamative nephritis*; and these are held to be true inflammatory affections, giving rise to organic changes of a peculiar kind. In the description of these changes, and of their relations to the different forms of renal degeneration described by former pathologists, there are considerable differences between the memoirs of Dr Johnson and Mr Simon, some of which will be presently adverted to.

In detailing the results of my observations on the anatomical changes in the kidney, I have avoided as much as possible all speculations as to the pathological causes or symptomatic phenomena of the lesions described. This branch of the subject I hope to take up at a future period; in the mean time, however, it is necessary, to prevent misconception, that I should repeat as regards the alleged scrofulous and rheumatic forms of renal degeneration, what I have formerly said in reference to the inflammatory and non-inflammatory,—that the application of such names to the anatomical changes in diseased kidneys is subject to this objection, that none of the lesions which I am engaged in describing, can be correctly considered as having an exclusive connexion with any specific pathological cause. In particular, I believe that there is no disorder of the system in general, or of the kidney in particular, with which the desquamative process is not liable to be connected, and that its connexion with the oleo-albuminous exudation is the most frequent of all.

I have therefore thought it necessary to exclude all names having reference to such vague pathological theories; believing that the lesions of an organ must be made the subject of purely anatomical consideration before its pathology can be rightly apprehended.

In some cases of desquamation of the epithelium, it is scarcely possible to recognise any departure from the usual condition of the kidney, either with or without the assistance of the microscope. The degree of vascularity is very various in different specimens, and the epithelium thrown off is so quickly resupplied, that there is no very observable change in the microscopic condition of the tubules. In one very intense case, in which ten pounds of very watery urine, loaded with an epithelial sediment, were passed daily for some weeks before death, the kidneys were small, flaccid, and bloodless; many of the tubes were quite full of nuclei heaped closely together; some of the nuclei were undersized; the cells, when entire, were much compressed and angular.—(See Fig. 15.) In another instance, where urine was passed in large quantity and full of epithelial debris, during the last two months of life, the kidneys were found in an opposite condition; viz. large and congested, and with a firmness and smoothness of section like the first stage of the waxy degeneration formerly described.—(See pp. 33, 34.) In this case the condition of the tubuli was in most parts quite natural; in some, however, there was extravasated blood, and in others the epithelium had accumulated to an abnormal extent. In both these cases there was imperfect development of the epithelium; but cases have occurred to me, in which this character was by no means well marked. The crowding of the tubes with nuclei, although frequently found in the earlier stages of desquamation, is not invariably present; and I have seen the tubes gorged with epithelium, in a case where none had been separated with the urine for weeks before death.

Fig. 14.

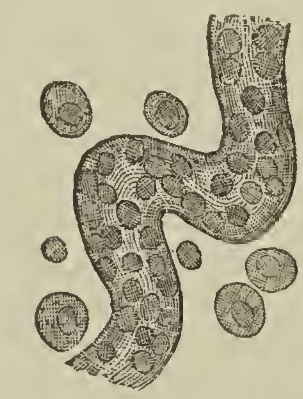

Fig. 15.

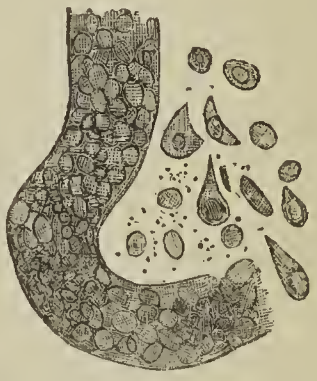

Fig. 14.—*A portion of a tubulus uriniferus normally filled with cells. It presents an obviously cylindrical form, and the nuclei are disposed on the internal surface so as to leave considerable intervening spaces. The cells and nuclei from such a tube are unaltered in form. (250 diameters.)*

Fig. 15.—*A tube crowded with nuclei and compressed cells. Some of the cells altered in form, and nuclei are seen mixed with debris, outside the tube. The nuclei are somewhat smaller than those of the healthy tube. (250 diameters.)*

So long, therefore, as the epithelium is freely regenerated, the kidneys may preserve a tolerably healthy appearance even on minute examination. The principal characters of the disease in this stage are derived from the urine. After prolonged disease, however, further changes take place. The epithelium becomes more sparingly generated, and is thrown off in the coherent masses above described (p. 42), leaving the basement membrane in portions bare, or with a few scattered oval nuclei, much smaller than those cast off, adhering to its inner surface.—(See Fig. 16.) In the microscopic examination of organs in this condition, there are frequently seen films of such exceeding delicacy and transparency as to be only visible by very careful management of the light. They preserve the shape of the tubules, and contain no nuclei or structures of any kind. Similar films are occasionally seen in the sediment of urine. They are probably thrown off from the denuded basement membrane.—(See Fig. 18.)

Obliteration of the Tubes.—The basement membrane, which, with the few closely adherent oval nuclei above described, is now the sole remaining structure of the tubes, soon undergoes a change.—(See Fig. 16.) It loses the cylindrical form proper to it in the fresh and natural kidney, and becomes flattened by the pressure of the surrounding parts. Its cavity is thus obliterated, and what was a tube assumes the appearance of a transparent riband, dotted here and there with small oval nuclei, which, when seen at the edges, appear to be enclosed between two layers of membrane. These riband-shaped portions of membrane appear to preserve considerable tenacity and elasticity; by their greater density, and by the constant presence of the small oval nuclei so often mentioned, between their layers, they are in most cases readily distinguished from the delicate films which have been referred to above. They are very various in diameter, but are always inferior in this respect to the normal tubes; and they appear to break up spontaneously into smaller portions, each of which contains from one to six, or even more, nuclei. These portions are of various sizes, from 1-10th to 1-4th of a millimetre in length, and from 1-120th to 1-30th in breadth. They are usually broadest in the middle, and taper to a point at both ends. The smallest of them contain only a single nucleus, and present an ap-

Fig. 16.

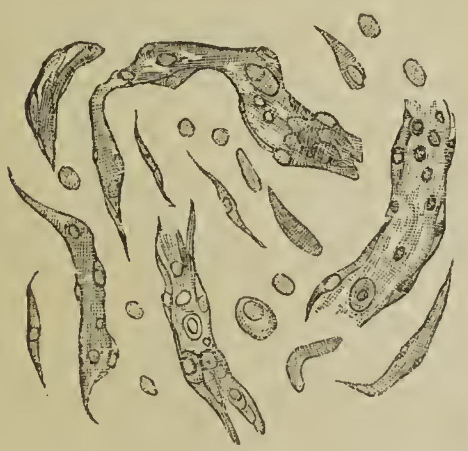

Fig. 17.

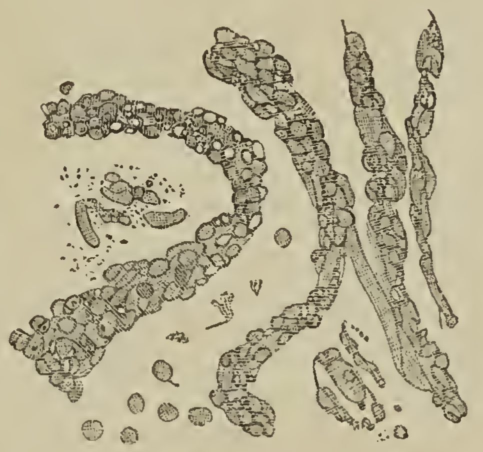

Fig. 18.

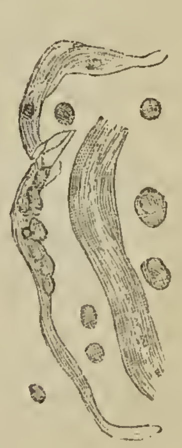

Fig. 16.—*Fragments of tubes from which most of the cells have separated, and which are undergoing the change mentioned above. Some small nuclei are seen adherent, and others free.* (250 *diameters.*)

Fig. 17.—*Debris of epithelium separated from the interior of the tubes, and presenting a mould of their form.* (250 *diameters.*)

Fig. 18—*Delicate films presenting the form of the tubes, and probably separated from their interior. Along with them a few nuclei and cells, which, however, are not imbedded in the membrane, as in Fig.* 16. (250 *diameters.*)

pearance in every respect like that of the young fibres of areolar texture, or those fusiform cells which have been called *fibro-plastic.* I think it probable that the whole of the diseased basement membrane ultimately splits up into fibres of this kind.[1]

While these changes are proceeding, the capillary vessels, which have ceased to be subservient to secretion, are usually obliterated. The consequence of this double obliteration of vessels and tubes, is a considerable degree of atrophy in the diseased parts; and, as the atrophy takes place at first chiefly in the cortical substance, great irregularities of the surface generally supervene. Thence arises the appearance so well described and figured by Dr Bright (Plate III. Fig. 2), in which, from the atrophy of the cortical substance, the bases of the pyramids "are drawn towards the surface of the kidney."

When oleo-albuminous exudation supervenes on the above derangement of the tubes, or when desquamation supervenes on the former (circumstances which I conceive to be of very common occurrence), the exudation most commonly takes the form of the granulations of Bright, which are deposited chiefly in the diseased tubes; and the atrophy proceeding around these they become salient, and the surface generally irregular, giving rise to the tuberculated state of the surface, so common in all the later stages of the granulated kidney (Bright, Plate III. Fig, 1; Rayer, Plate VII. Fig. 6; Plate IX. Fig. 8.) As the atrophy, however, proceeds, the granulations are gradually absorbed; and when the kidney has become extremely contracted and irregular, they often in great part disappear.

The atrophied portions of the kidney are usually exsanguine and of a tawny or drab colour; they have considerable hardness and toughness. Examined microscopically, they appear to consist of fibres and fusiform cells in great abundance, and more or less granular exudation, according to circumstances. According to Henle, Eichholtz, Gluge, and others, these fibres are in great part new formations; Johnson and Simon consider them as nothing more than the compressed parenchyma of the gland, from which all the other normal elements have disappeared. I look upon them as formed in great part by the breaking up of the basement membrane of the tubes (as above-described), as well as from the parenchyma and obliterated capillaries. It is not improbable, however, that, in addition to these elements, some new fibrous tissue is formed.

The extreme stage of the atrophied kidney is nearly the same whether exudation have existed or not.

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[1] I have never seen any reason to believe, with Mr Simon, that the tubes in diseased kidneys burst from over-distension, discharging their contents into the inter-tubular tissue. The separation of the epithelium from the tubes, under the pressure of glasses, takes place to a considerable extent even in healthy organs, and much more in disease; but it is the result of the manipulation, not a pathological appearance.

Microscopic Cyst-formation.—It occasionally happens, on examining the section of a kidney with the microscope, that we see scattered through some parts of the section a few small clear vesicles of nearly circular or oval form; they are either of a very pale straw-colour, or nearly colourless, and are perfectly clear and translucent, with a very distinct shadowed margin, which causes them to stand out in bold relief from the other textures composing the section. Their diameter is usually from 1-40th to 1-15th of a millimetre, but in this respect they vary considerably; sometimes they appear to lie in the tubular areolæ, and at other times to be unconnected with these. Very rarely they have appeared to contain a few granules; most commonly, even when there is granular exudation around them on every side, they contain nothing but clear fluid. Their refractive power is not so great as that of oil, while it is much greater than that of the spherical cells of the tubes. Hence their distinct and characteristic shadowed outline.—(See Figs. 19 and 20.)

Fig. 19.

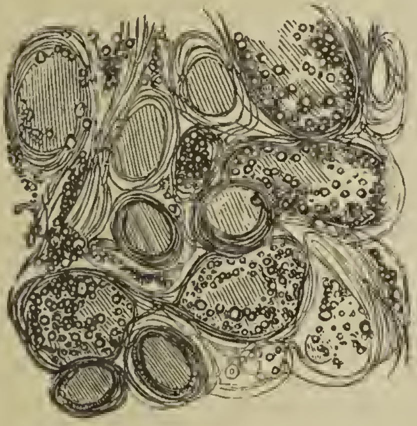
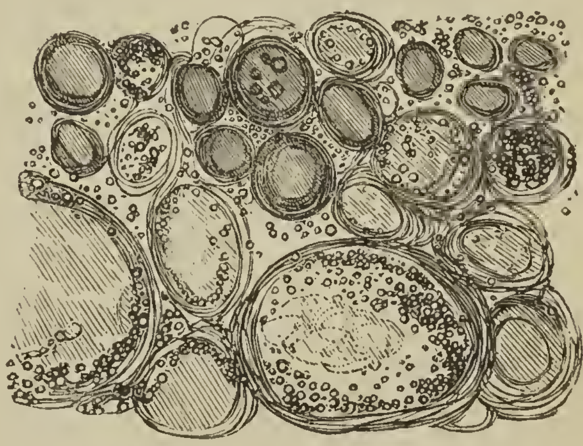


Fig. 20.



Figs. 19 and 20.—*Vesicles described above, dispersed amid the normal elements of the section of the kidney. There is a considerable quantity of granular exudation in the Malpighian capsules and tubular areolæ. One vesicle in Fig.* 20 *contains two or three granules, but all the rest are quite clear. In Fig.* 19, *a tube contorted, and here and there apparently much constricted, is seen to pass from the left* (*below*) *to the right* (*above*). *One of the vesicles lies over a constricted portion, and two others are seen in contact with the tube below.*

These bodies (which, however, have never appeared to me to present distinct nuclei) are probably the same with the "nucleated cells or vesicles" described by Mr Simon, as resulting from the extravasation of the epithelial cells into the intertubular tissue, and as progressively enlarging so as to form the cysts visible to the naked eye, which are so common in diseased kidneys. To these structures he attaches great importance in the pathology of the kidney, conceiving them to be the invariable result of the desquamative disease when of long standing; the kidney being, in Mr Simon's opinion, changed more or less into an aggregation of microscopic cysts, which either undergo absorption, and lead to atrophy of the organ, or increase in size and monopolize its texture. Thus, according to Mr Simon, the serous cysts so common in the kidney result from an enormous development and hypertrophy of extravasated epithelium cells, which assume the character of the vesicles he describes, and acquire the power of increase and endogenous development.

Whether the bodies described by me above, are the same with the vesicles of Mr Simon, I have some difficulty in determining; but they are the only objects I have seen which correspond at all closely with his description, unless, indeed, it were possible to suppose, as Dr Johnson appears to hint,[1] that he may have mistaken the normal disposition of the tubuli (See Fig. 1, and *ante*, p. 9) for a cystic structure.

However this may be, I am satisfied that the vesicles above described are exceptional productions, and by no means invariably connected, as Mr Simon describes his vesicles to be, with the progress of the desquamative degeneration. They are seen in comparatively few cases; on referring to four, of which I have drawings or memoranda, I find two to have been congested and waxy kidneys, with slight exudation, one to have been a soft and desquamating kidney, also with slight exudation, and one a granular kidney, with numerous cysts, from the size of a pea to that of a hazel-nut. On the other hand, I have examined organs in every stage of desquamative disease without finding these bodies, the production of which cannot therefore be an essential step in the degeneration and atrophy of kidneys so affected.

The origin and progress of these vesicles is very obscure. It is not improbable that, as Mr Simon asserts, they are transformed into the larger cysts visible to the naked eye; though I confess that I have not been able to trace the intermediate steps of their progress in a satisfactory manner. On the other hand, their origin from extravasated epithelial cells seems exceedingly improbable; indeed, I have already stated that I do not think the epithelium ever becomes extravasated. Moreover, the vesicles in question have all the appearance of being formed *within* the tubes, although they afterwards become separated from them.

From the occasional appearances of alternate distension and constriction presented by the tubes when undergoing obliteration, I am induced to believe that cysts may be formed by the occlusion and isolation of portions of tube which have not yet lost their power of secretion. Whether the vesicles in question are formed in this way, can only be determined by close and repeated observation; and I have not been able to obtain demonstrative evidence on this point. The observation in Fig. 19, however, though not free from sources of fallacy, appears to me to favour this view.

The larger cysts in the kidney present very strong evidence of being formed in connexion with the secreting membrane. In one instance I found their inner surface to be lined at some points with tesselated epithelium, in the form of pentagonal or hexagonal flattened cells, with circular nuclei; in another case there were oval nuclei without any distinct cells, and a large number of free oil-globules of considerable size. The existence of oil in these cysts has also been observed by Dr Johnson. Other products of secretion are also occasionally found. On one occasion I found several cysts in a kidney otherwise healthy in appearance, which contained a turbid ochrey-coloured liquid, presenting under the microscope numerous minute crystals of uric acid. Mr Simon mentions having found on two occasions xanthic oxide in considerable proportion. I have more than once observed them to contain blood in large quantity, and I have likewise found them full of a matter like stiff glue.

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[1] See first part of article Ren, in Todd's Cyclopædia of Anatomy and Physiology, just published and not yet completed.

The occurrence of cysts in kidneys presenting a generally healthy structure is so frequent, as to lead to the idea that they must be in such cases the result of disease which has been arrested before any considerable disorganization has taken place. Many of the cases of partial atrophy of the kidneys figured by Rayer (see Plate V. Figs. 5, 6; Plate XXXV. Figs. 8, 9, 10), are probably due to the rupture or obliteration of these cysts.

Before leaving the subject of cyst-formation, I may state, that in one instance I have observed the Malpighian capsules to be occupied by distinct cysts. This case will be presently detailed.

Dilatation and Thickening of the Tubes.—This condition, although by no means a very frequent one, is important as being characteristic, so far as I have observed, of the extreme stages of what I have called the "waxy degeneration." I have scarcely ever seen it unaccompanied by entire obliteration of the vessels, and by enlargement and increased density of the kidney. The organ has the dense, resistant feeling of fibro-cartilage, and both cortical and tubular portions have the light yellow colour, and the appearances described above, pp. 34, 35, as those of the waxy degeneration in its last stage. The striæ of the pyramids appear to radiate indefinitely towards the surface, and meet the cortical substance in digitations, instead of being marked off by a sharp semicircular line, as occurs in the healthy kidney. When examined with a simple lens, or even the naked eye, the pyramidal striæ are seen to pursue an unusually sinuous course; this is peculiarly the case where they pass into the cortical substance. Moreover the pyramids are unusually broad at the bases; and the length of the straggling digitations is sometimes so great, that I have measured fully an inch and a half between the extreme end of the striæ and the corresponding papilla. Nevertheless the cortical substance is not usually diminished in quantity, being developed to a great extent between the pyramids.

This condition I have ascertained to proceed from dilatation and thickening of the tubuli uriniferi throughout the organ. The dilated tubes are usually twisted and varicose, as may be seen by inspecting a section of the pyramids with a low power.—(See Fig. 21, A.) When examined with a higher power, the section presents an appearance very similar to some tumours (of the fibrous or fibro-cystic kinds); viz. a number of compressed areolæ, enclosed by fibrous tissue, and presenting an appearance of irregular concentric rings of various distinctness, (an effect apparently due to the peculiar refraction of light by the thickened membrane.)—(See Fig. 21, B.) The nuclei are obscured or invisible, owing to the thickness of the intervening wall, but nevertheless exist in considerable numbers. The Malpighian bodies and capillaries are usually obliterated. The kidney has in fact become, like the tumours whose structure it resembles, a true non-vascular texture.

Fig. 21.

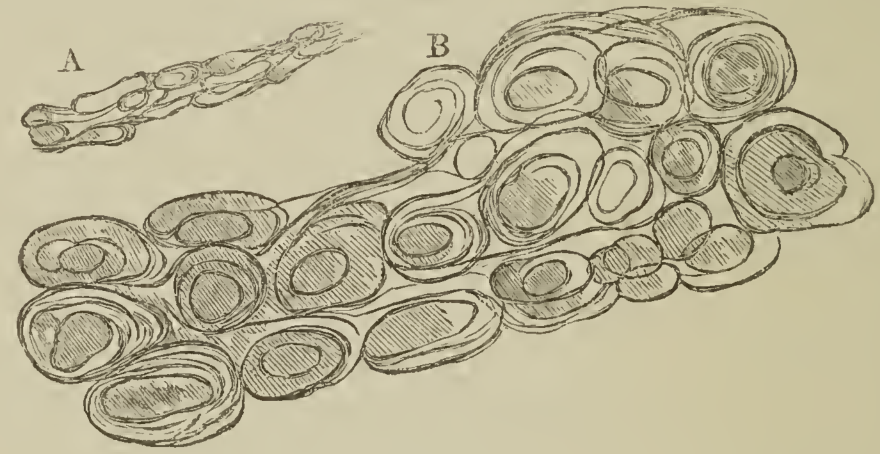

Fig. 21. A.—*Tubes in the pyramidal substance of the kidney, in the case of Campbell.* (Observation XIV.) (40 *diameters.*) B. *A similar section* (*as described above*). (170 *diameters.*)

The explanation of the peculiar extension of the pyramidal striæ towards the surface in these cases, is to be found in the fact, that even in the normal condition the convoluted tubuli have a general disposition from the bases of the pyramids towards the surface, in the direction of the striæ of the cones. This is evident from the facility with which the gland tears in that direction; although in the normal state this disposition is masked by that of the vessels, which, passing in straight lines through the cones, break into a complicated net-work of capillaries at the bases of the pyramids. In the present lesion, the vessels having disappeared, and the course of the tubes being strongly marked, their disposition towards the surface becomes manifest, and the abrupt line of demarcation between the cortical and pyramidal substance, caused by the presence of the vessels, is obliterated.

A very characteristic instance of this lesion is found in Observation XIII. It may be worth while to remark, that in this case the lesion above described occurred in common with bronchial dilatation, there being thus a precisely analagous state of the pulmonary and renal texture. In the following case there are several unusual circumstances—the amount of exudation—the persistance of some of the vascularity of the surface and pyramids—and the cysts of the Malpighian bodies.

Observation XIV.—*Waxy Kidney* (*last stage, with Granular Exudation*). *Cysts in Malpighian Capsules.*—Agnes Campbell, æt. thirty, was admitted into the Royal Infirmary, February 8, 1848, under the care of Dr George Paterson. She laboured under great general anasarca, and was extremely anemic. There was a murmur with the first sound of the heart. The urine was found to be highly albuminous, specific gravity 1·012, acid reaction. She died February 20th.

On dissection, the external aspect was excessively anemic; the face was puffy, the legs œdematous. The cavities of the chest and abdomen contained a considerable quantity of fluid. All the organs were sound, except the kidneys. These were enlarged by about a fourth, and were firm and dense. The capsule was easily stripped; the surface not uneven; the venous vascularity less than usual, and irregularly distributed. The cortical substance generally was of a yellowish colour, with some opacity, and destitute of vascularity. The yellowish opaque colour penetrated between the tubular striæ towards the bases of the pyramids, which were broad, and displayed a good deal of vascular injection. The Malpighian bodies were prominent on the surface of the section, and presented an unusually transparent and pale appearance.

On examining microscopically a section by Valentin's knife, there was seen dispersed among the tubes of the cortical substance a considerable quantity of very finely granular exudation. A few cells presenting the appearance of the granular or exudation corpuscles were seen. The nuclei in the tubuli were mostly free from cell-walls. There were numerous fusiform cells and rudimentary fibres. The Malpighian capsules were thickened, and no blood-vessels could be seen in their interior, which was divided into loculi.

On separating the Malpighian bodies from the capsules (which was readily done by scraping the cortical substance), and viewing them either with strong or weak powers, they were seen to be composed of pale semi-transparent cysts, from 1-15th to 1-12th of a millimetre in diameter, and compressed together. When floated out, they presented the appearance of a cluster of grapes, except as regards the form of the individual cysts, which was circular. They were apparently retained together by a very slight medium, as by a little manipulation several of them could readily be separated from the mass. They appeared to contain transparent fluid.

The above transformation of the Malpighian bodies has not escaped the attention of Rayer, who says that in an advanced stage of the *Néphrite Albumineuse* "the glandules of Malpighi resemble small serous vesicles, mingled with others a little larger, which still later became true cysts."—(See Rayer's Atlas, Pl. IX. Figs. 6. and 7.) In the case just detailed, however, there was no enlargement of any of the Malpighian bodies.

CONCLUSION.

With the view of enabling the reader to place the foregoing observations in relation with the descriptions found in systematic pathological works, I subjoin the following short remarks on the principal physical characters usually ascribed to diseased kidneys.

Increase of Size and Weight—Hypertrophy.—Enlargement of the kidney occurs chiefly in consequence of three conditions; 1st, from sanguineous engorgement; 2d, from distension of the tubes by secretion or exudation; 3d, from permanent dilatation and thickening of the tubes. Of all these causes, the second is by far the most common. The last is characteristic of the waxy degeneration formerly described.

The quantity of liquid in the tubes is at all times subject to so much variation, that it is difficult to say what amount of increase of weight may be thereby occasioned without the existence of any positively morbid condition. It is not very uncommon to find kidneys otherwise not differing from the healthy standard, about double the usual weight, or between seven and eight ounces each. I have more than once found them to weigh nine ounces each, with very slight marks of disease. When the weight much exceeds this, it is probable it arises from the rare combination of vascular and tubular engorgement.

In kidneys containing oleo-albuminous exudation, the greatest increase of size is attained when the exudation is universal, and unaccompanied by desquamation.

Cystic degeneration of the kidneys, dilatation of the pelvis and ureters (Hydronephrose, Rayer), &c., also give rise to great increase of size and weight.

Diminution of Size and Weight—Atrophy.—This condition sometimes occurs to a certain extent in emaciated subjects, without any disorganization, owing to the diminished activity of secretion. More frequently, however, it is the result of separation of the epithelium, followed by contraction and obliteration of the tubular structure.

Atrophy, from this cause, is liable to supervene in all other varieties of renal lesion, except the waxy degeneration, which appears to lead to a permanently hypertrophied condition of the organ. In kidneys enlarged from exudation, the occurrence of desquamation and its consequences is frequent; and the diminution of size in such cases, is often not followed by a return to the natural condition but by permanent atrophy.

The course of all disorganizing diseases in the kidney, is to produce first enlargement, and then contraction of the organ. In the extreme stages of the atrophy which results from exudation, exudation is often nearly absent. When exudation therefore, even in very sparing quantity, accompanies a contracted condition of the kidney, there is a probability that it has been abundant at some former period.

Irregularities of Surface—Tuberculated and Granulated Kidneys.—The smoothness of the surface in the kidney is destroyed either by unequal dilatation, or unequal contraction of the tubuli of the cortical substance. The former takes place in the waxy degeneration, the latter in the desquamative processes.

The most frequent irregularities of surface are formed in connection with the granulations of Bright (the origin of which is described, See *ante*, p. 12). These are invariably formed when exudation is deposited in kidneys tending to the desquamative lesion; and, as this runs its usual course, the granulations become prominent from the destruction of the tubes around them. An extreme degree of the irregularities thus produced constitutes the tuberculated kidney.

The puckering and partial atrophy occasionally seen in kidneys otherwise not morbid, or comparatively slightly diseased, are probably in many instances the result of the obliteration of cysts.

The more remarkable changes in colour and consistence are described very fully in many parts of the preceding memoir.

On reviewing the whole of the observations, the result of which I have now laid before the public, I am induced to regard the following conclusions as especially important in relation to the pathology of renal diseases :—

1. By far the greater part of the pathological lesions of the kidney arise from, or are connected with, the exudation of oleo-albuminous granules into the interior of the tubes and epithelial cells.

2. The oleo-albuminous exudation is probably often preceded, and certainly occasionally accompanied, by vascular congestion; but when the quantity of exudation is considerable, more or less complete depletion of the vascular system invariably occurs. This is a secondary result of the obstruction of the *tubuli uriniferi.*

3. The oleo-albuminous exudation occurs in two chief forms; viz. *first*, Universal infiltration of the tubes throughout the organ; and *second*, Infiltration of particular sets of tubules, the rest remaining free, or nearly so. In the latter mode arise the granulations of Bright.

4. There is no essential anatomical difference between the exudations in the kidney which are the result of chronic processes, and those which have been considered as the result of inflammation.

5. The capillary vessels of the kidney are subject to spontaneous obliteration (unaccompanied in the first instance by any visible lesion of the tubes), giving rise to the peculiar affection which I have called the *waxy degeneration.* This obliteration of the vessels is probably in all cases preceded by a stage of congestion.

6. The consequence of the waxy degeneration is thickening and varicose dilatation of the tubuli throughout the organ.

7. The tubes of the kidney are subject to contraction and obliteration, in consequence of the desquamation of their epithelium; a condition resulting in atrophy, and complete disorganization of the organ.

8. The desquamation of the epithelium occurs very frequently in all the other diseased conditions of the kidney. When sufficiently long-continued and extensive, it produces contraction, and this indifferently whether exudation be present or not. It is sometimes accompanied by vascular congestion in every stage of its progress.

9. The earlier stages of the exudations can only be discovered by means of the microscope. The progress of the waxy degeneration, on the contrary, is best traced by the unaided eye. The desquamation of the epithelium is only to be discovered with certainty by means of the microscope, and is particularly apt to escape attention, under all circumstances, if the *kidney* only, and not the *urine*, be looked to. It results that careful investigation, both by the micro-

scope and the naked eye, both of the kidney after death and the urine during life, are indispensable to enable the pathologist to determine with exactitude the presence or absence of disease.

[I propose to publish the results of my observations on the urine, and on the pathology of Bright's disease, and other diseases of the kidney, as soon as some investigations suggested by the present series of papers are completed.]